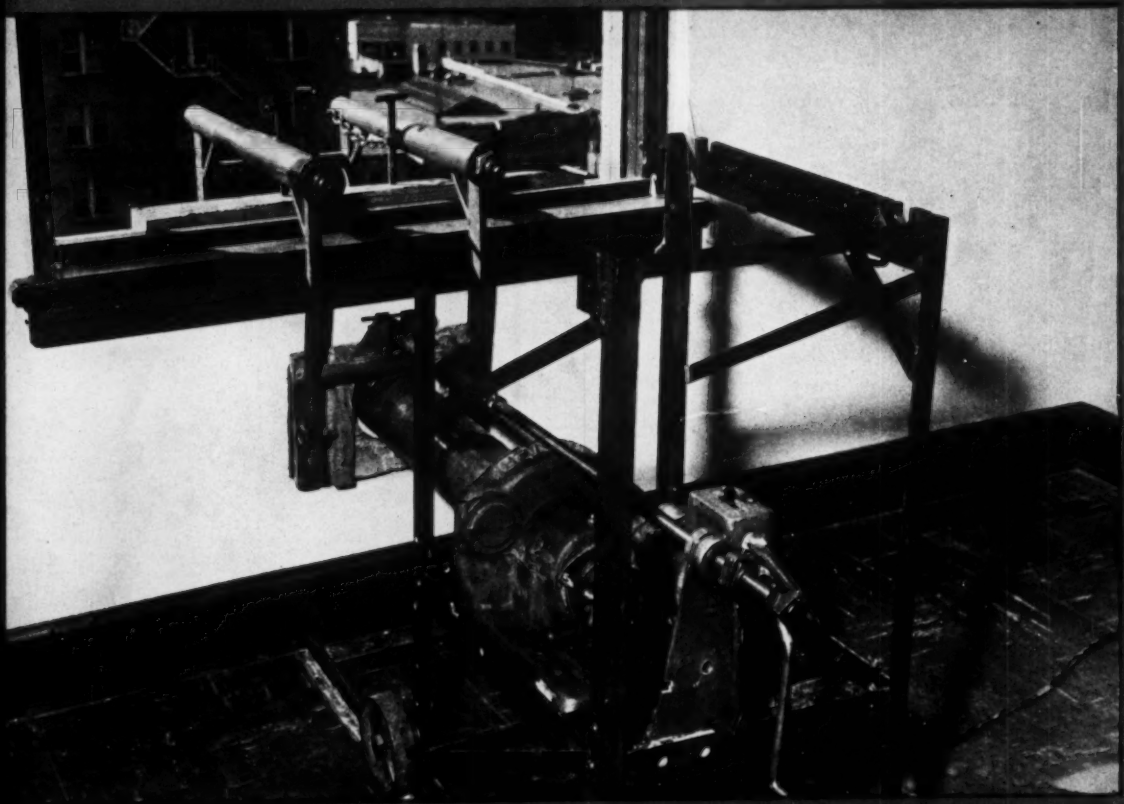
Heating Piping & Air Conditioning

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

JULY ★ 1951

INDUSTRIAL
COMMERCIAL
INSTITUTIONAL AND
PUBLIC BUILDINGS

Page 111—Journal Section of The American Society of Heating and Ventilating Engineers



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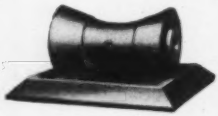
ADJUSTABLE PIPE HANGERS AND SUPPORTS

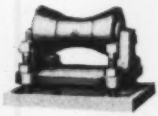
for every piping requirement

NO. 3 OF A SERIES SHOWING THE GRINNELL LINE

pipe rolls

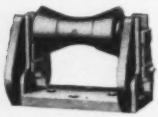


Pipe Roll and Plate
Fig. 277
2 to 30 in. pipe

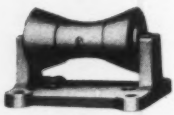


Adj. Pipe Roll with Base
Fig. 274
Without base: Fig. 275
2 to 30 in. pipe

Adj. Swivel Pipe Roll
Fig. 174
2½ to 12 in. pipe



Adj. Pipe Roll
Fig. 276
4 to 30 in. pipe



Pipe Roll Complete
Fig. 271
2 to 30 in. pipe

Single Pipe Roll
Fig. 171
1 to 30 in. pipe

pipe saddles

Pipe Stanchion Saddle
Fig. 259
4 to 36 in. pipe

Adj. Pipe Saddle Support
Fig. 264
2½ to 36 in. pipe

Pipe Saddle Support
Fig. 258
4 to 36 in. pipe

Anchor Chair
Fig. 197
4 to 24 in. pipe

Pipe Covering Protection Saddle
Figs. 185, 186, 187, 188
Type A for 10 in. and smaller

Pipe Covering Protection Saddle
Figs. 185, 186, 187, 188
Type B for 12 in. and larger

Write for Hanger Catalog

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WHENEVER PIPING IS INVOLVED

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Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
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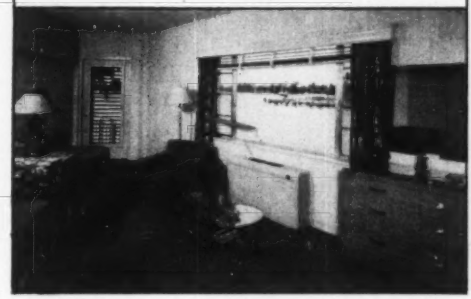
Tools of Air Conditioning

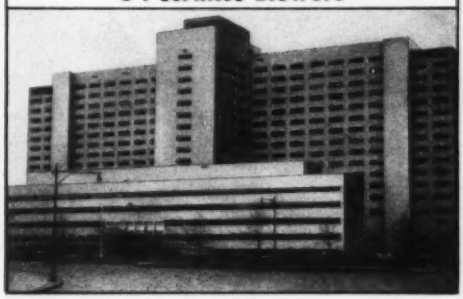
JOB IDEAS BY usAIRco

MODU-AIRE means "no ducts"



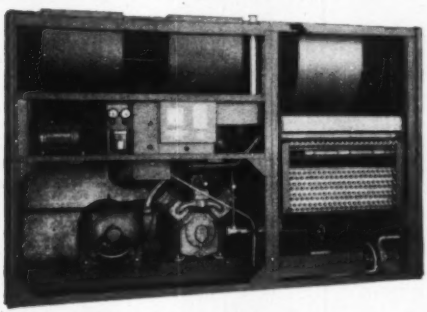
Timely tip! If the job's one of air conditioning an existing building, Modu-aire is your best bet. No need to rip out walls or partitions: no ducts required. Simply install individual Modu-aire units in each room and connect to central conditioning source with piping. Widely used in both new construction and remodeling.

1,000 Bed Hospital: 54 usAIRco Blowers



Where the most exacting requirements must be met, usAIRco centrifugal blowers qualify in every respect. That is why they were selected to handle the air-moving job in the Fort Hamilton Veterans' Hospital, Brooklyn. Model chosen is the Type A backwardly inclined blower. Selection was made by U. S. Army Engineers.

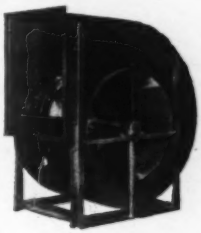
Complete Central Heating-Cooling



It's usAIRco's REFRIGERATED KOOLER-AIRE! Contains the 3 major components of an air conditioning system in one compact unit—connected, charged, tested, balanced, ready to run. No complicated plumbing layouts, water towers or extra wiring. Just 3 easy connections to water, electricity, ducts. Cuts water consumption as much as 95%. Can be equipped for heating job too, by adding coil.

Type A Blower with non-overloading characteristics

Blower chosen for the Veterans' Hospital above is especially adaptable to schools, hospitals, offices, factories. It is ideal for many types of installations. Wide range of sizes. Send for Bulletin 440.



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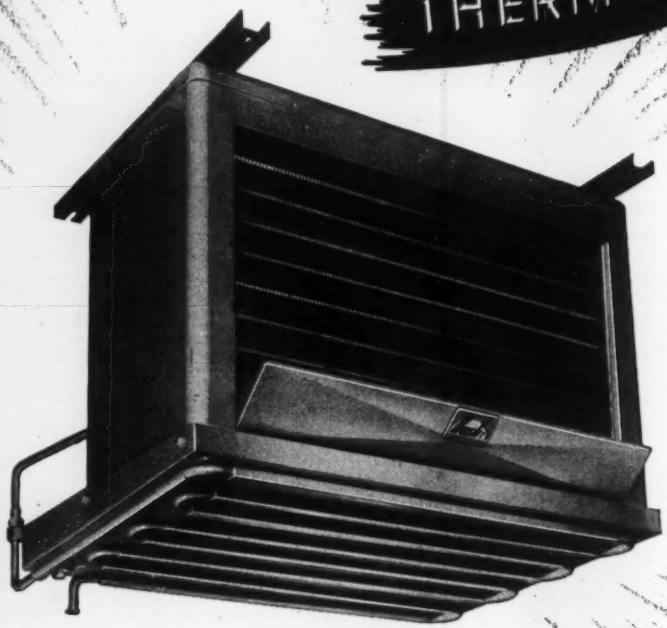

The ultimate in hot gas defrosting

Therm-o-cycle is a simple refrigeration system using room air passed over a re-evaporator coil to furnish the heat required for defrosting. Dependable, automatic and trouble-free Therm-o-cycle has been proven in thousands of fixture installations the world over. Now, this system is available for larger commercial installations.

Write for Bulletin No. 525 which gives complete specifications and instructions.

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Heating Piping & Air Conditioning

Vol. 23, No. 7

(with which is merged the Aerologist)

DESIGN, INSTALLATION, OPERATION AND MAINTENANCE IN INDUSTRIAL, COMMERCIAL, INSTITUTIONAL AND PUBLIC BUILDINGS

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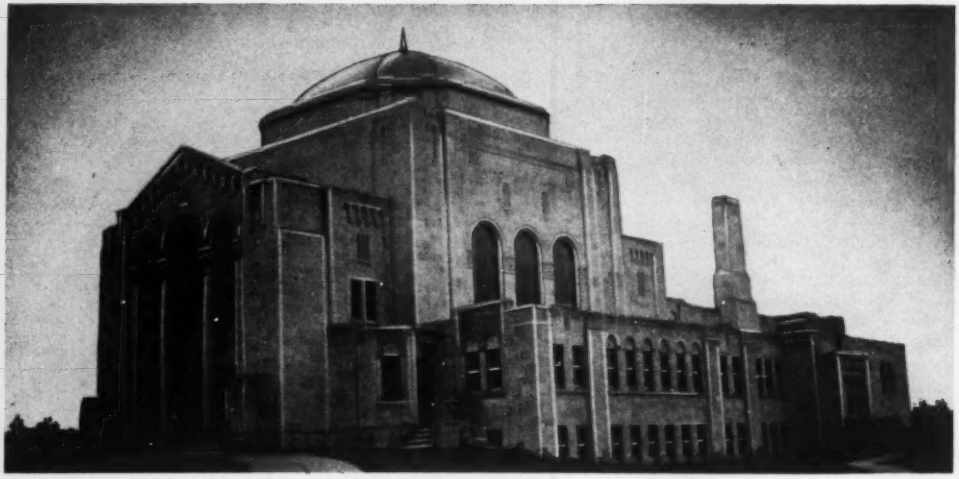
WARM AIR HEATED... by Campbell



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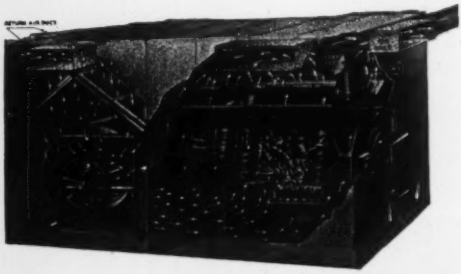

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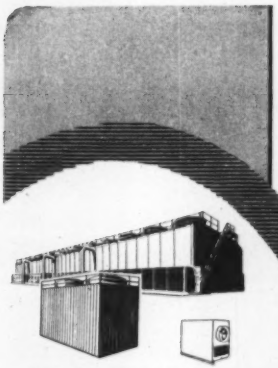
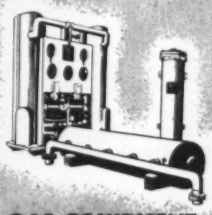


COOLING TOWERS



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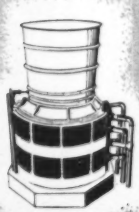

AIR COOLED HEAT EXCHANGERS

WATER CONSERVATION AT WORK

Here's Why

You'll Want to Specify *The* Pritchard "SRF" TOWER!

Low cost Pritchard Series "SRF" Cooling Towers are especially designed for air conditioning or refrigerating installations requiring 3 to 24 tons capacity. Louver boards, louver posts and top framing are made of finest California Clear-Heart Redwood for *long life.* Steel pipe distribution system assures efficient, *trouble-free* performance.

"SRF" Towers are shipped complete with basin. "Slip-fit" construction gives easy access to interior of tower. All bolts, nuts, washers and nails needed for complete assembly are included. Full instructions furnished for quick field assembly.

For lowest initial cost, longest life, greatest efficiency, specify and install the Pritchard "SRF" Tower! Your inquiry invited.

Write for *FREE* Bulletin No. 5.9.081

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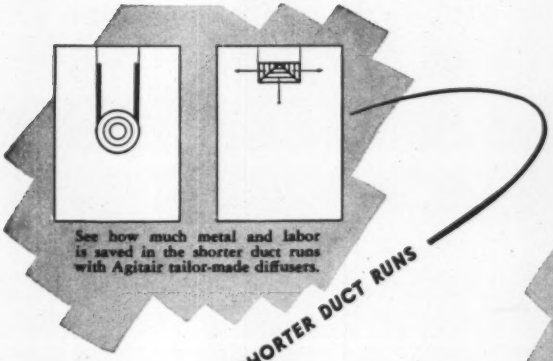

See how much metal and labor is saved in the shorter duct runs with Agitair tailor-made diffusers.

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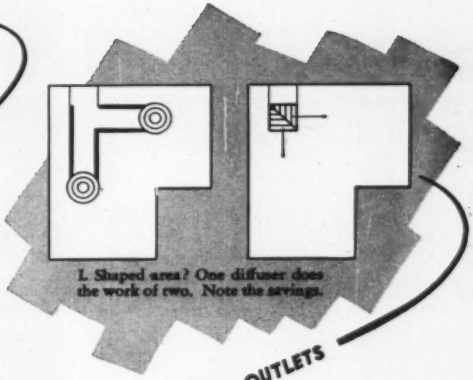

L Shaped area? One diffuser does the work of two. Note the savings.

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Save Metal...

Cut Costs...with

CONSERVE CRITICAL MATERIALS

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SQUARE & RECTANGULAR AIR DIFFUSERS

Compare the diagrams on this page and you'll understand why today — more than ever before — it's important to specify AGITAIR Type R. They are the only diffusers that may be assembled in a variety of patterns to provide blows in one — two — three and four directions, with discharge orifices proportional to the area being served. Yes — you can help overcome the metal shortage and reduce the cost of duct work — *without reducing the efficiency of air distribution.* Specify AGITAIR . . . the only air diffuser tailor-made for each application.

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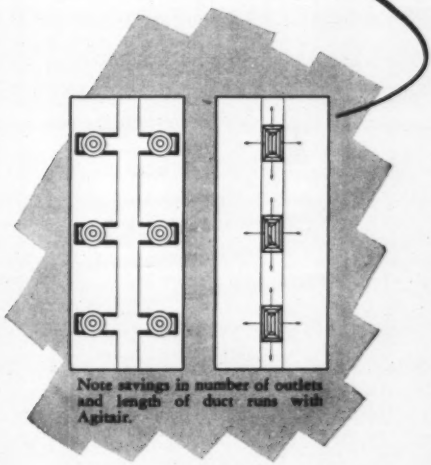

Note savings in number of outlets and length of duct runs with Agitair.

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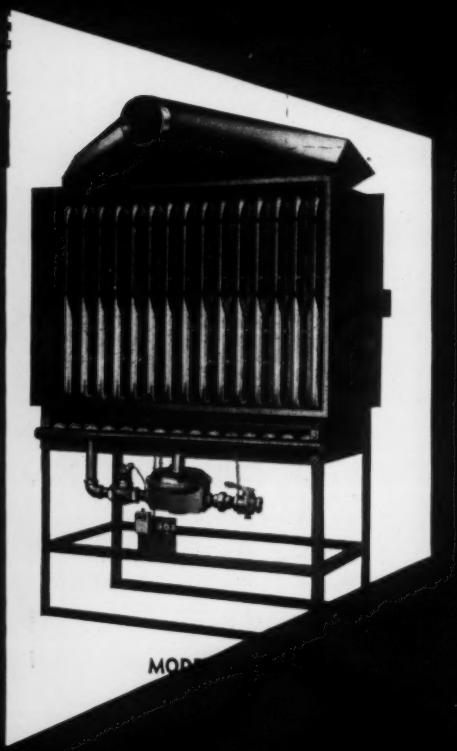
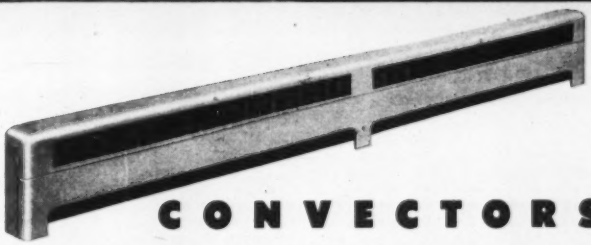
Air Diffusers • Air Filters • Roof Exhausters

The Only Air Diffuser Tailor-Made for Each Application



HOW TO ELIMINATE PICTURE WINDOW DRAFTS!

INSTALL YOUNG LOW-LEVEL CONVECTORS



Architects and heating contractors find the Young low-level convector-radiator line ideal for picture window installations. The streamlined, compact cabinets are just 12″ high—stand inconspicuously beneath the sill, or hide away in wall recesses. The generous selection of sizes range from 20″ to 112″ in length, and 4″, 6″, and 8″ in depth— meet any hot water or two-pipe steam system requirement.

What's more, you can rely upon Young ratings. These "FL" models, like the standard line, have been tested and rated in accordance with Commercial Standard CS 140-47, as developed cooperatively by the trade and national Bureau of Standards, U. S. Department of Commerce.

Young low-level models offer many distinctive design features to make specification and installation most satisfactory. The coupon, below, will rush you a copy of our new Catalog No. 4150 just off the press. You'll find it filled with helpful information.

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Young Quality

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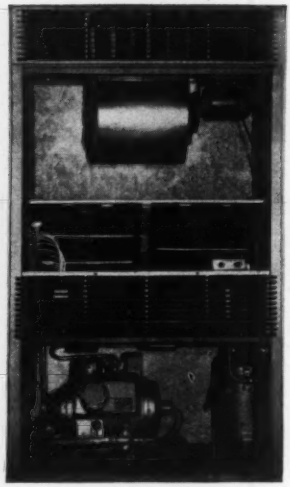


IN A PACKAGE AIR CONDITIONER

Here are the reasons why your customer will be happy with his Worthington Package Air Conditioner:

QUIET—acoustically insulated cabinet . . . no belts to wear or get out of line.

VIBRATION-LESS—smooth-floating multi-mounted compressor . . . dynamically-balanced fan.

TROUBLE-FREE—compressor hermetically-sealed against dust and moisture . . . no pulleys, couplings or seals.

NO ATTENTION NEEDED—pressure-type oiling . . . never needs replenishing.

LONG LIFE—compressor surfaces finished to micro-inch accuracy . . . oversize bearings . . . four rings per piston . . . dynamically-balanced crankshaft.

SAFE—high-pressure cut-out . . . high temperature safety switch.

CONVENIENT—finger-tip selection of temperature . . . thermostatic control . . . finger-tip adjustment of louvres.

ATTRACTIVE—plastic baked-enamel finish, scratch-resisting, washable . . . rounded corners, no projections . . . no "sweating".

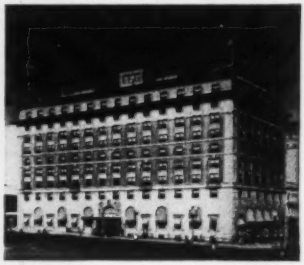
ECONOMICAL—thermally-insulated . . . large copper-finned cooling coils . . . Worthington Feather* Valves.

Each Worthington unit—3, 5 and 7½ ton sizes**—is built to the same high quality standards as Worthington equipment for engineered systems, such as those described at the right. *Write for Bulletin C1100-B29.*

*Reg. U. S. Pat. Off. **Also, for remote location: 7½, 10, 15, 20, 25 ton units

Another "Worthington-Conditioned" hotel

in the National Hotel Co. chain



The 400-room Washington Hotel, one of the leading hotels in the nation's capital, gets its air conditioning from a Worthington centrifugal refrigeration system, using chilled water. This is one of five National Hotel Company hotels to be Worthington-conditioned; the others are Hotel Jung, New Orleans; Travis Hotel, Dallas; Thomas Jefferson Hotel, Birmingham; Hotel Cortez, El Paso.

Off-and-On heat calls for Off-and-On cooling

The work performed in the research laboratory of Aluminum Company of America, East St. Louis, Ill., is of such a nature that excessive heat is produced intermittently.

Certain of the rooms are provided with a "wild zone" of air conditioning which goes into operation automatically when the heat-producing equipment is in use, and the normal air conditioning zone cannot handle the load.

This building is handled by a 125-ton Worthington air conditioning system comprised of two Freon-12 compressors and one evaporative condenser.

WORTHINGTON

AIR CONDITIONING AND REFRIGERATION

INVESTIGATE

MORE WORTH WITH WORTHINGTON

Consult Classified Telephone Directory for nearest Worthington distributor. Worthington Pump and Machinery Corporation, Air Conditioning and Refrigeration Division, Harrison, N. J., specialists in air conditioning and refrigeration for more than 50 years. A1.3

Where pipes meet permanently...

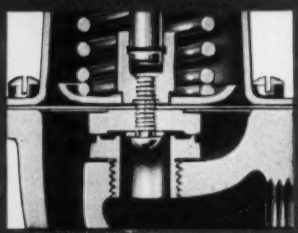
WATSON-STILLMAN

DISTRIBUTOR PRODUCTS DIVISION WATSON-STILLMAN ESTABLISHED 1848 • ROSELLE, NEW JERSEY

Designers and Manufacturers of Forged Steel Fittings, Valves, Wire Rope Shears, Hand Pumps, Vacks, Pipe Benders and Hydraulic Equipment

YOU CAN DO A *BETTER* JOB WITH B & G

Hydro-Flo ASME RELIEF VALVES



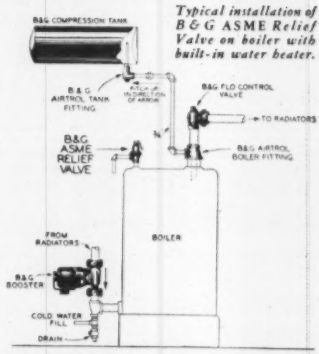
Built to ASME Code . . . tested and rated by National Board

These new Relief Valves are an important addition to the B & G line . . . because many cities and states are requiring ASME rated relief valves which have capacities equal to or greater than the maximum output of the boiler.

B & G Relief Valves with ASME ratings offer these features in excess of Code requirements:

1. They are not "pop" type valves. Diaphragm operation transmits more power during opening and closing of valve.
2. No guides on discharge side to stick or jam.
3. New low differential of not to exceed three pounds between opening and closing pressures.
4. Ground and polished metal-to-metal seats. Age or use will not deform them.

Wide range of capacities permits close matching of relief valve capacity to boiler load. Be sure to examine this new line of B & G Valves before you buy again.



Typical installation of B & G ASME Relief Valve on boiler with built-in water heater.

B & G Hydro-Flo Products protect your most valuable asset—customer satisfaction!

B & G Booster

B & G Flo-Control Valve

B & G Monoflo Fitting

B & G Tankless Heater

BELL & GOSSETT
COMPANY

Dept. CC-5, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada *Reg. U. S. Pat. Off.

IF IT'S PERFORMANCE YOU WANT

BUY FROM THE PEERLESS *Fluidyne* LINE...

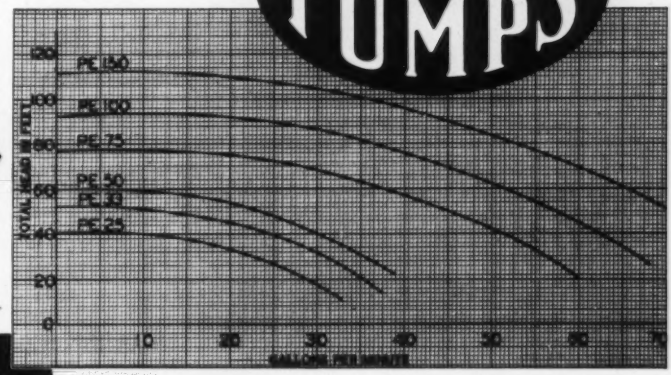
PEERLESS PUMPS

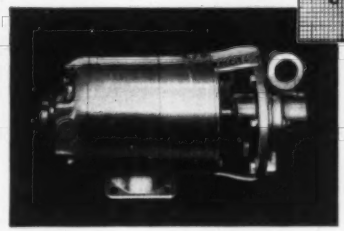
FOR FRACTIONAL HP PUMP USERS

HERE ARE THE RATINGS

HERE'S THE PUMP

PEERLESS *FLUIDYNE* TYPE PE PUMP ¼ TO 1½ H.P.





KEY TO CHART
Performance chart showing head capacity characteristics of Peerless Type PE fractional hp Fluidyne pumps at 3450 rpm

KEY TO PUMP HP
PE 25—¼ hp
PE 33—⅓ hp
PE 50—½ hp
PE 75—¾ hp
PE 100—1 hp
PE 150—1½ hp

GET HIGHEST EFFICIENCY plus

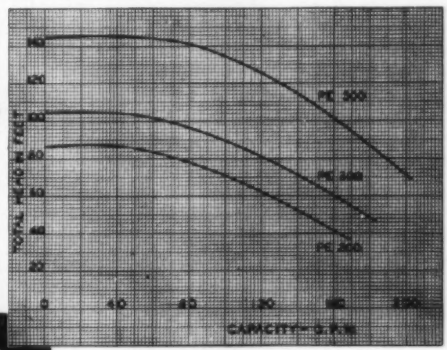
COMPACTNESS • ECONOMY DURABILITY AND EASY MAINTENANCE

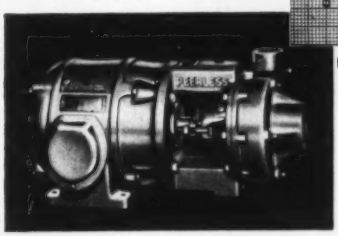
FOR INTEGRAL HP PUMP USERS

HERE ARE THE RATINGS

HERE'S THE PUMP

PEERLESS *FLUIDYNE* TYPE PE PUMP 2 TO 5 HP





KEY TO CHART
Performance chart showing head capacity characteristics of Peerless Type PE integral hp Fluidyne pumps at 3450 rpm

KEY TO PUMP HP
PE 200—2 hp
PE 300—3 hp
PE 500—5 hp

Peerless offers in the Fluidyne line of end-suction horizontals, both electric and pulley-driven or flexible coupled models from ¼ hp to 150 hp. Capacity range: up to 5500 gpm; head range: up to 260 ft. New Bulletin B-2300 describes the line completely.

Mail Coupon Today!

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Address inquiries to Factories at:
Los Angeles 31, California and Indianapolis 8, Indiana
Offices: New York, Chicago, St. Louis, Atlanta; Dallas, Plainview and Lubbock, Texas; Fresno, Los Angeles; Phoenix; Albuquerque, New Mexico.

PEERLESS PUMPS fmc

Peerless Pump Division
Food Machinery and Chemical Corporation
301 West Avenue 26, Los Angeles 31, Calif.

Please send without obligation new Bulletin B-2300 describing Fluidyne line of fractional and integral hp pumps.

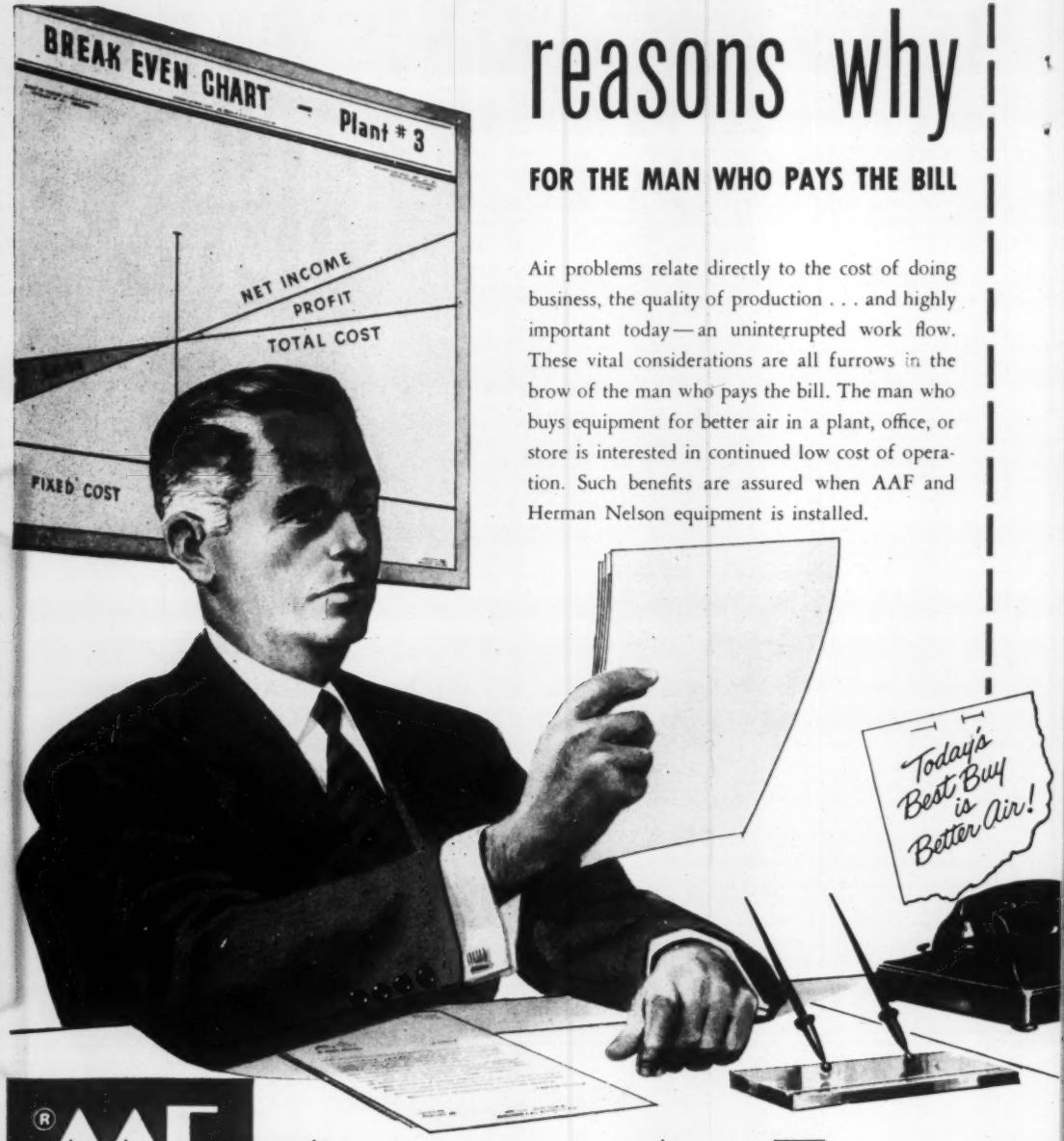
NAME _____

COMPANY _____

STREET _____

CITY _____ STATE _____

HPAC



reasons why

FOR THE MAN WHO PAYS THE BILL

Air problems relate directly to the cost of doing business, the quality of production . . . and highly important today—an uninterrupted work flow. These vital considerations are all furrows in the brow of the man who pays the bill. The man who buys equipment for better air in a plant, office, or store is interested in continued low cost of operation. Such benefits are assured when AAF and Herman Nelson equipment is installed.

AAF

American Air Filter

COMPANY, INC.

HERMAN NELSON DIVISION

herman nelson

PLANTS: LOUISVILLE, KENTUCKY MOLINE, ILLINOIS

TYPICAL EXAMPLES OF EFFICIENCY IN OPERATION...

Take the case of AAF's Electro-MATIC. The installation at the right is protecting a huge investment in industrial equipment. It eliminates dust, dirt and even smoke from the air, so equipment will last longer . . . require less maintenance . . . perform more efficiently. The Electro-MATIC not only *super-cleans* air, but insures highest filtering efficiency at all times by automatic operation and self-cleaning features.

Only long-time engineering experience—the kind AAF has in abundance—can offer these advantages . . . the kind that makes sense to dollar-conscious management men who must pay the bill.

- Highest cleaning efficiency . . . over a wide range of particle sizes, from smoke to largest air-borne material.
- Minimum Maintenance . . . self-cleaning action and automatic operation eliminates shut-downs necessary with manual maintenance.
- Uniform Air Volume . . . provided by non-clogging filter curtain.
- Absolute Safety . . . as entire casing and exposed parts are electrically grounded.
- Easily Installed . . . in standardized self-contained sections that require no watertight duct construction.

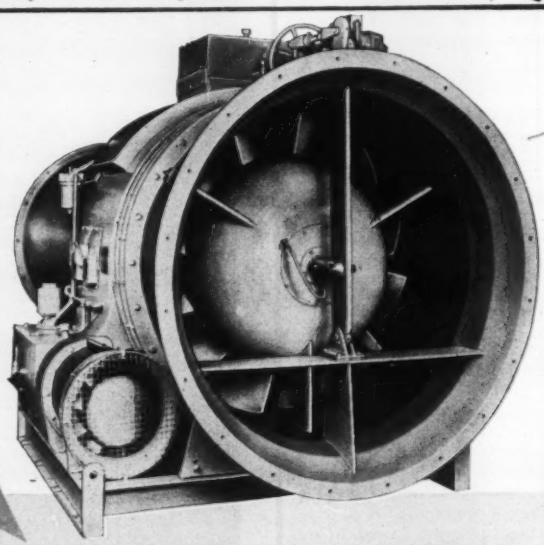
Next time you have a problem involving air cleaning equipment, come to the one source that has all types of *specialized* air cleaning equipment . . . where you can be sure you won't be offered a substitute that isn't quite as good. Call on AAF, we'll be glad to work with you.

HERMAN NELSON

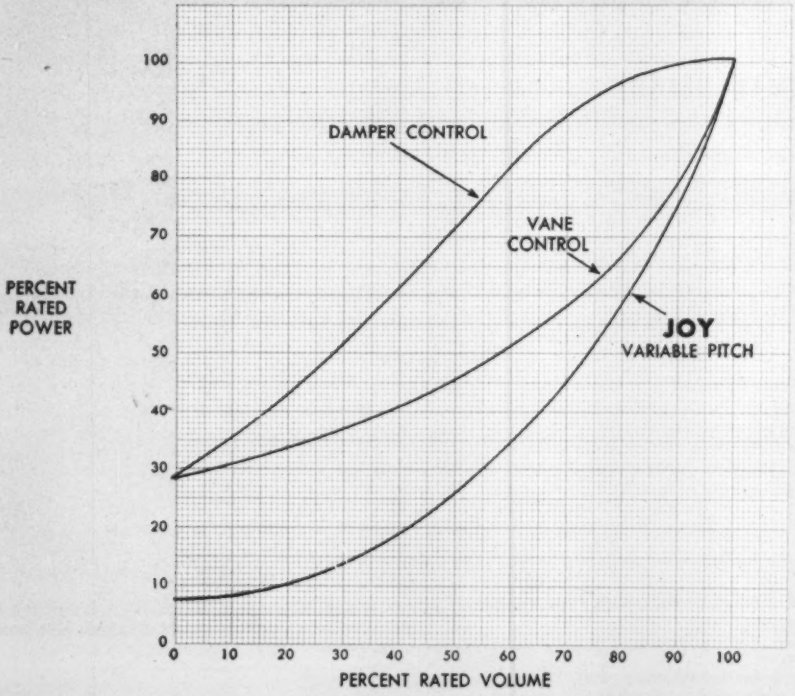
UNIT BLOWERS—Another outstanding example of a high efficiency, low maintenance cost unit that has become a standard specification for all Herman Nelson equipment. Compact in design for minimum space requirements, all Unit Blowers are assembled at the factory as complete ventilating units. Dependable and long lasting, these units are ideal where economy of operation and extra efficiency are both prime considerations. Tested and rated in accordance with Standard Test Code. Write for complete specifications and performance ratings.

PROPELLER FANS—Low initial installation and maintenance costs make Herman Nelson Propeller Fans the wise choice for the man who pays the bills. The exclusive "air foil" design of the fan blades increases efficiency and permits quieter operation. A wide range of models in either belt drive or direct drive has proven on installations to be the most economical form of mechanical ventilation obtainable. Write for descriptive booklet which gives sizes and performance data. Remember—there are good reasons why it's wise to buy the product that carries the Herman Nelson name.

Look How You Can SAVE POWER at REDUCED VOLUMES ..

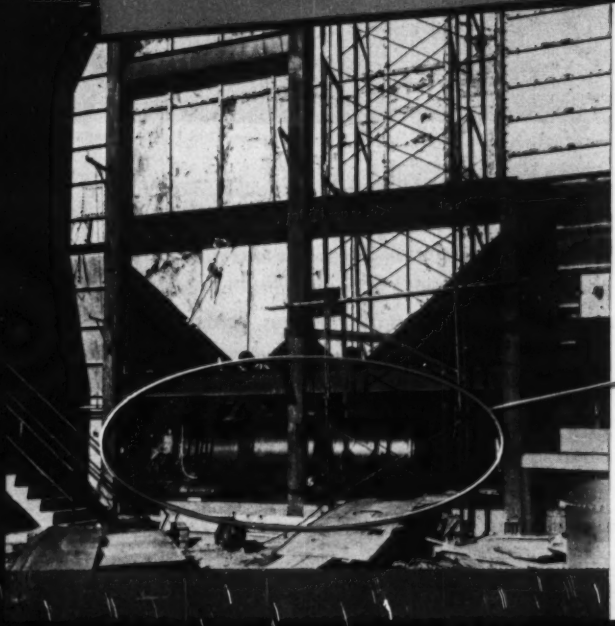


COMPARISON CURVES OF VOLUME CONTROL METHODS



...with JOY AXIVANE® FORCED DRAFT FANS

...employing VARIABLE-PITCH BLADES manually or automatically controlled



ADVANTAGES and EXCLUSIVE FEATURES

JOY Forced Draft Fans with Variable-Pitch Blades are ideally adapted for any desired type of automatic control, or can be readily manually controlled. The response is quick and accurate.

Operating at constant speed, direct-connected, these JOY Fans are of the well-known vaneaxial type. This highly efficient design affords the most favorable air volume-to-power consumption ratio, as well as low noise levels. The design is compact and simple, requiring minimum headroom and promoting easy installation, ready servicing, and trouble-free operation with least maintenance. • On fans for pressurized-type boilers or "cyclone" furnaces, check first with JOY—world's largest manufacturer of vaneaxial-type fans.

HERE'S A TYPICAL JOY INSTALLATION

Notice how compactly the fan with its sound-absorbing set tucks away under the boiler in minimum space. This 400 HP JOY Variable-Pitch Fan is serving a pressurized-type boiler in a new southwest power station. It is 66" in dia., operates at 1750 RPM, and supplies 80,000 CFM at 25" WG.

1851-1951 . . . 100 YEARS OF ENGINEERING LEADERSHIP

Consult a Joy Engineer

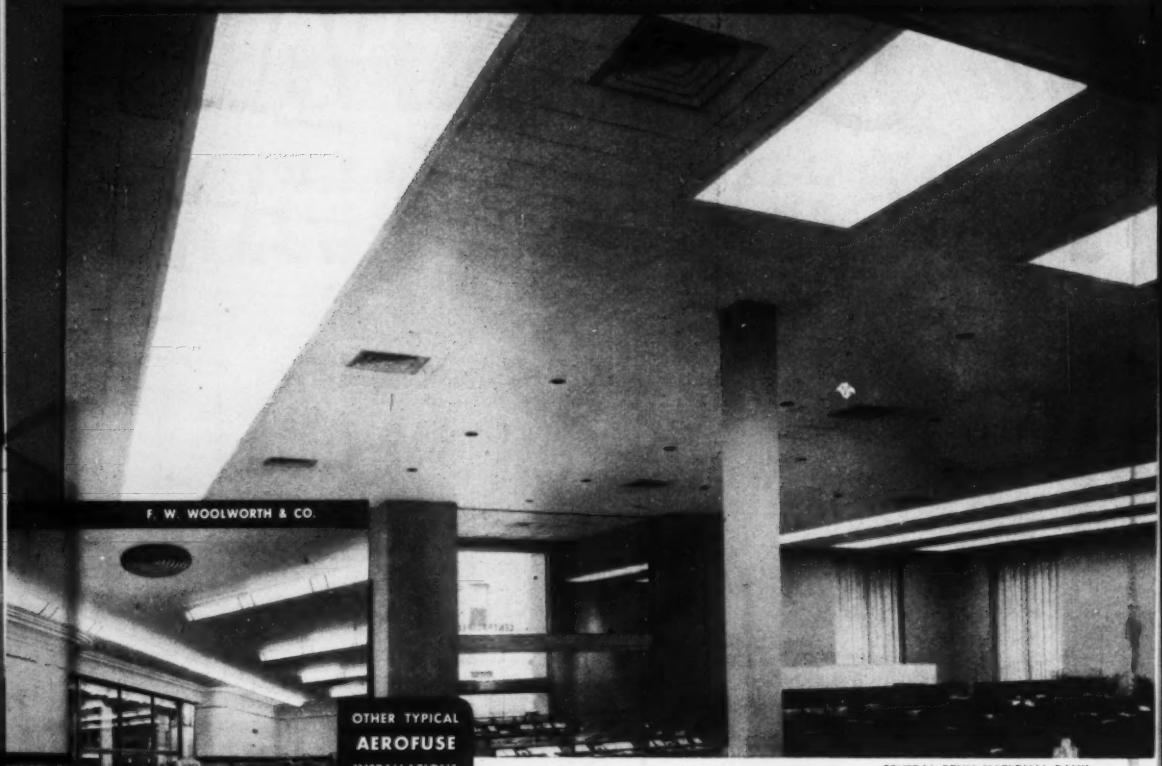
WAD 13654

JOY MANUFACTURING COMPANY

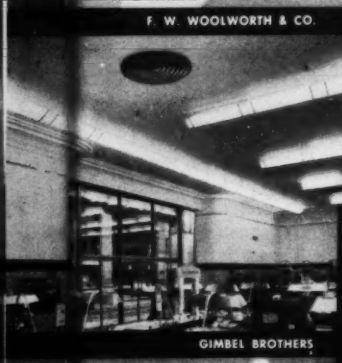
GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

Aerofuse IN PHILADELPHIA



CENTRAL PENN NATIONAL BANK



F. W. WOOLWORTH & CO.

GIMBEL BROTHERS

GOLDMAN THEATRE

OTHER TYPICAL **AEROFUSE** INSTALLATIONS IN THE PHILADELPHIA AREA

- Philadelphia Inquirer
- Sharp & Dohme
- John Wanamaker
- Rittenhouse Claridge
- Sagre Junior High School

Whether you shop, work or relax in air conditioned comfort in the Quaker City, there's a good chance that Aerofuse Diffusers are there, too. For, as in other cities the country over, important air conditioning jobs in historic Philadelphia are Aerofuse jobs. In department stores, theatres, banks, offices, etc.—where conditions and requirements vary widely—the men responsible for these installations know from experience that when they select diffusers from the Aerofuse line they will meet the most rigid specifications of performance and appearance . . . *at the vital point of air delivery.*

Send for your copy of Aerofuse Catalog 104 . . . complete information, size selection data, engineering details.

TUTTLE & BAILEY inc

NEW BRITAIN, CONNECTICUT

all three agreed it would provide four definite savings

Immediately after this small Motorpump was used for recirculating water in air conditioning systems all agreed that at last they had a different pump with lower hp that would do the work of ordinary pumps of higher hp. Yes, the man who bought the air conditioning unit on which the pump was installed, the contractor who put in the system and the I-R engineer who helped design the pump found that the Motorpump *offers* four definite savings.

1. **Saving in *first* cost**
2. **Saving in weight and space**
3. **Saving in installation costs**
4. **Saving in power costs**

This remarkable Motorpump is just one of the results of 90 years of Ingersoll-Rand research and experience. The Motorpump has proved itself to be higher in efficiency and reliability when compared *size* for *size* with *any* other type pump used on air conditioning systems today!

Knowing this, you can't honestly afford to pass up the savings this Motorpump offers. Certainly, it's worth your investigation. For facts and figures, contact your nearest I-R distributor or representative. Meantime, write direct for this booklet, "A Picture of Improved Pumps for Air Conditioning" Ingersoll-Rand Company, 11 Broadway, New York 4, New York.

Ingersoll-Rand

90 years of BIG PUMP know-how packed into small pumps for air conditioning applications

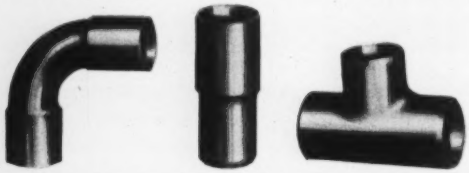
MOTORPUMP

look! ...it must be a Streamline® fitting!

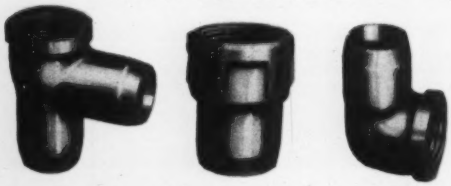
Streamline® solder type fittings are really made to last . . . and they'll make a neater, quicker installation

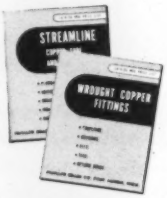
If Cleopatra's plumber had used STREAMLINE fittings we wouldn't be surprised if they would still be in pretty serviceable condition today. For STREAMLINE solder type fittings are really made to last. They cannot rust, they're not loosened by vibration and they're virtually free from clogging. STREAMLINE fittings assure a snug-fitting, tightly joined system that tests leak-proof on the first try and doesn't develop leaks later. When you install STREAMLINE fittings, you can be sure you're installing a permanently reliable conducting system whether for plumbing, heating, air conditioning or industrial use.

And here's something else . . . because of their design, precision manufacture and accurate dimensions, STREAMLINE solder type fittings can be installed quickly and the uniform depth of the solder joints makes it easy to compute the exact length of tubing needed. Thus STREAMLINE fittings not only assure a permanent installation, they also reduce job cost and increase the number of installations a contractor can handle.



STREAMLINE wrought and cast fittings are available in a complete range of standard sizes.



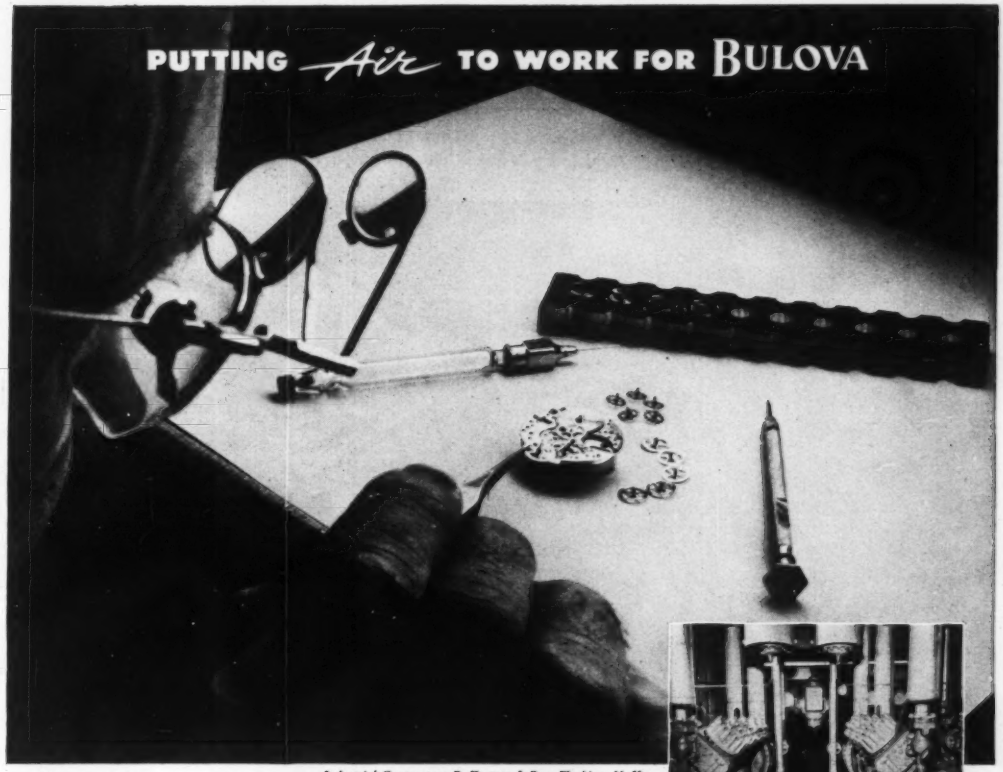


See your jobber for further information or write for catalogs S-351 and W-251 describing our complete line of STREAMLINE wrought copper and cast bronze fittings.

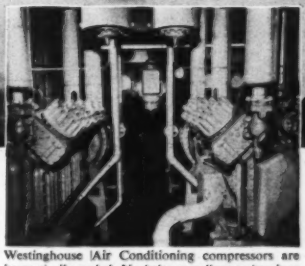
65

MUELLER BRASS CO. STREAMLINE PRODUCTS

MUELLER BRASS CO. PORT HURON 1, MICHIGAN



Industrial Contractor: P. Kretzer & Son, Flushing, N. Y.
Air Conditioning by: Abbott, Lester & Co., New York, N. Y.



Westinghouse Air Conditioning compressors are hermetically sealed. No belts or pulleys to break or get out of adjustment. 2 to 100 ton capacities.

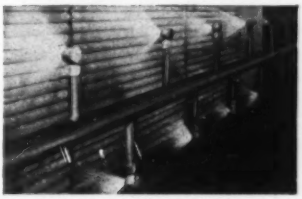
HOW TO MAKE TIME IN A CONTROLLED ATMOSPHERE

Airborne dirt and moisture are poison to precision instruments. Even the tiniest specks and droplets help inaccuracies or corrosion get a toehold and grow during assembly processes.

That is why Bulova used Westinghouse Air Conditioning and PRECIPITRON®, that cleans air electronically . . . to make air work *for* them through the entire plant. Production and assembly of uniformly precise movements are safeguarded . . . and fingers that touch finely finished surfaces don't perspire and cause corrosion.

You can *put air to work*, too—with air conditioning, air cleaning or air moving equipment. Call the Westinghouse Air Conditioning Distributor in your classified phone directory, or write Westinghouse Electric Corporation, Air Conditioning Division, Hyde Park, Boston 36, Massachusetts.

PRECIPITRON is three times more efficient than the best mechanical air cleaner. Dirt particles are held on collector plates until washed away.



Air washing aids in precise humidity control . . . helps cool in summer, reduces static electricity in winter to keep dust off clean surfaces.

YOU CAN BE SURE...IF IT'S

Westinghouse

J-80216

Simplify Your Oil Burner Layouts
with this Modern Pipe Heating System!

"Simplicity of Thermal Electric design eliminates all of the headaches that go with the obsolete gadgetry of steam pipe heating.

"The pipelines are clean. Cumbersome steam heating has been junked in favor of passing low-voltage current through the pipeline itself. The heat generated makes even the crudest fuel flow like light oil.

"The fantastic jungle of pipes involved in recirculation has been scrapped. No need for them now since heat source is independent of boilers and burners.

"The ingenious Thermal Electric Tank Unit makes *unheated* storage practical. It eliminates steam coils in the fuel with their hazards of condensation, and leakage of oil into steam lines.

"On top of all this, Thermal Electric *guarantees* 100% automatic, trouble-free operation!

"What more could any engineer ask? Simplify your next bunker oil layout by specifying a Thermal Electric *Standard* System!"

HOW IT WORKS

Transforming Energizer (A) passes safe 20-volt current through the same pipe that carries the fuel (B). Oil is kept heated evenly at 120°F. over entire system. Thermostat (C) controls heat, makes system 100% automatic.

During intermittent shut-downs, fuel temperature is maintained automatically. During seasonal shut-down, fuel can solidify — Thermal Electric will melt out the pipe system.

HPS-1

PAT. NO. 2,224,403

Thermal Electric Fluid Systems Inc.

Fluid Systems Inc., 1881 Dixwell Ave., New Haven 14, Conn.

Please send me "The Common Sense of Heavy Fuel Transport" plus Customer List of hundreds of satisfied users.

*Name*_____ *Position*_____

*Firm*_____

*Address*_____

*City*_____ *State*_____

Move Any Industrial Fluid

Any Distance, at Any Temperature!

"Free yourself from the limitations of old-fashioned pipe heating methods with Thermal Electric Systems!

"With this all-electric transport system, it no longer matters how hot you must keep the fluid, how far you must move it, nor how exact your temperature control must be.

"Even the most acutely temperature-sensitive fluids are safely handled. Passing low-voltage current through the pipe that carries the fluid spreads even, low-density heat over the entire system, eliminating hotspots. Thermostatic controls won't let temperature vary more than 2°F.

"Different ambient temperatures are no longer a problem, as fluid temperature will not vary. Systems in tandem will bring fluid from cold exteriors to hot indoors with no temperature change.

"If you have a tough heating problem with any fluid, take a good hard look at versatile Thermal Electric *Industrial* Systems for viscous fluid transport!"

Fluid Systems Inc. are specialty engineers in the handling of industrial viscous fluids. We are available as special aides to consulting or staff engineers in designing transport systems for any fluid.

YEARS OF PERFORMANCE

American Can Company
Paraffin: 6,889' at 160°F.

Kentile Inc.
Resin: 1,515' at 400°F.

Minnesota Mining & Mfg. Co.
Phenol: 235' at 130°F.

Owens-Corning Fiberglas Corp.
Asphalt: 2,528' at 160°F.

Peter Cailler Kohler Swiss Chocolate Company
Chocolate: 1,307' at 100°F.

The Wm. J. Wrigley Jr. Co.
Glucose: 755' at 180°F.

PAT. NO. 2,224,403 HPI-1

Thermal Electric Fluid Systems Inc.

Fluid Systems Inc., 1881 Dixwell Ave., New Haven 14, Conn.

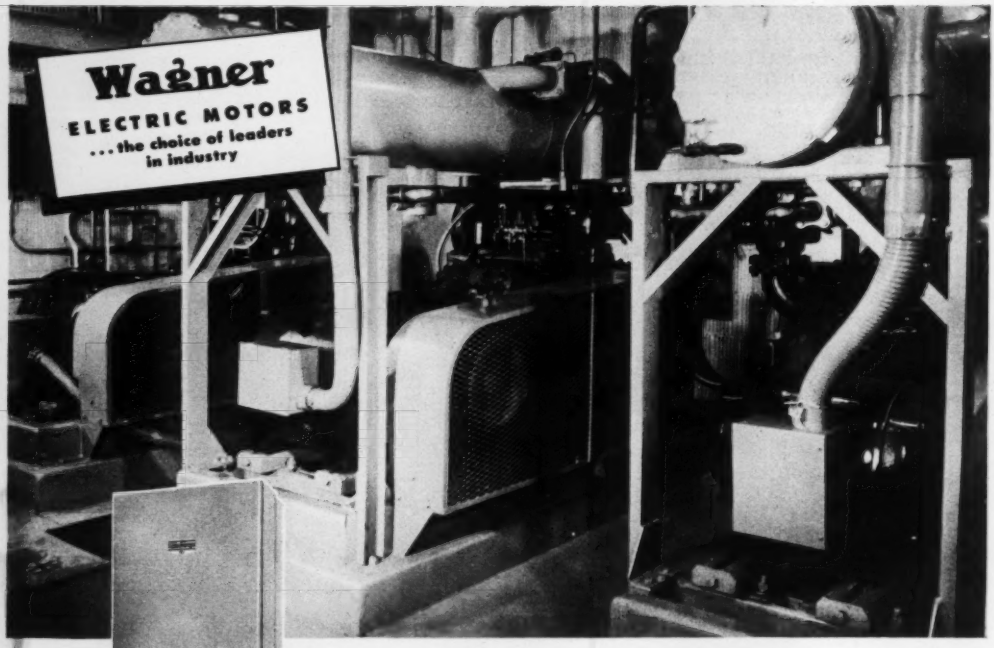
Please send me "Simplified Industrial Fluid Transport Cuts Costs" plus customer list.

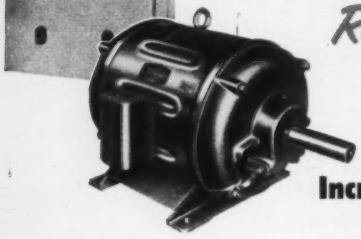
*Name*_____ *Position*_____

*Firm*_____

*Address*_____

*City*_____ *State*_____





Reduce starting current draw

the economical way with the Wagner Increment Motor and Starter Combination

On any application where reduced current draw at start is required because of locked current restrictions, you can limit the in-rush of motor current during the starting period with the low cost Wagner Increment Motor and Starter "Package."

A typical installation is shown in the photograph above, where three Wagner open-type general purpose motors rated 60, 100, and 125 hp are driving Worthington air conditioning units in a Minneapolis office building.

The Wagner Motor-Control Package is economical to install and permits the use of high grade magnetically operated control equipment at a low purchase price. For special requirements, the motor-control combination can be furnished with Wagner normal or high torque explosion-proof motors, splash-proof motors, or totally-enclosed fan-cooled motors as well as with the open type motor.

Why not investigate this Wagner combination today? Write for full information, or consult the nearest of Wagner's 31 branch offices, located in all principal cities.

® Wagner Electric Corporation
1891 WE 1951

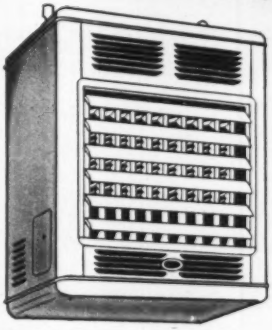
WAGNER ELECTRIC CORPORATION
6370 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS – AIR AND HYDRAULIC

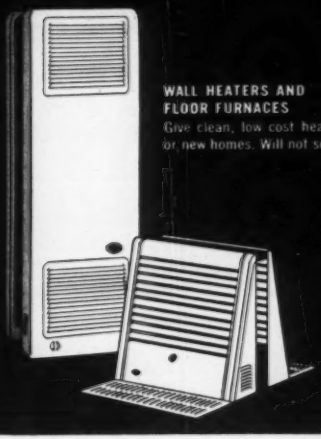
BRANCHES IN 31 PRINCIPAL CITIES

M51-17

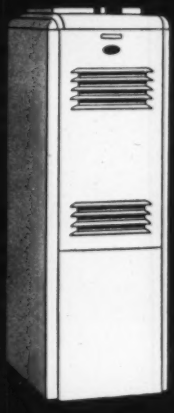
UTILITY



UNIT HEATERS
Furnish efficient "spot heating" in stores, plants, schools, churches and recreation centers.



WALL HEATERS AND FLOOR FURNACES
Give clean, low cost heat in old or new homes. Will not soil walls.



FORCED AIR FURNACES
Provide the finest in automatic, quiet, warm-air-heat for larger homes, etc.

Utility builds more sales for you

HERE'S WHY: The wide range and variety of Utility Gas Heating Equipment gives more models to choose from—one to fit every problem and every purse. Soundly engineered and sturdily constructed, Utility equipment gives years of satisfactory customer operation. This builds business for you year after year. Feature the *complete* Utility line for more profits. Write *now* for information about Utility dealerships. For year-'round business, sell Utility Cooling, too!

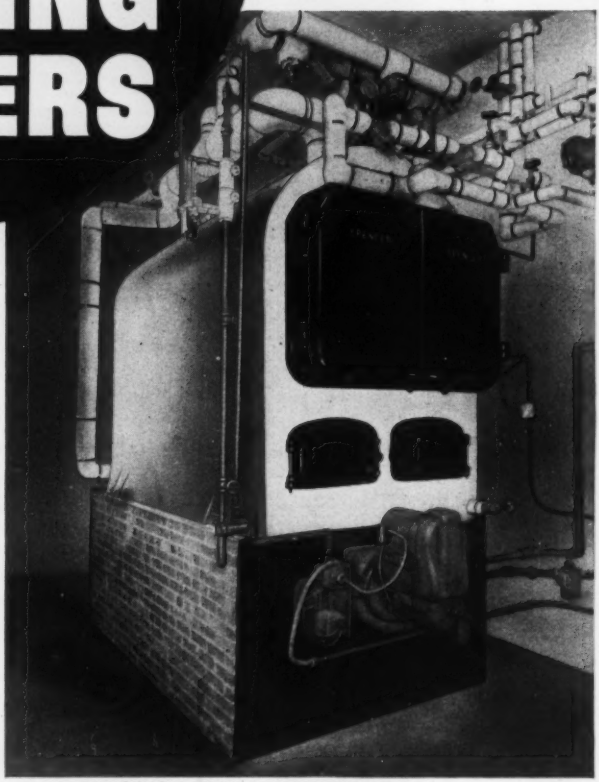
UTILITY
TRADE MARK
Guaranteed heating performance

UTILITY APPLIANCE CORP. 4851 So. Alameda St., Los Angeles 58, Calif.

The Nation's Foremost Manufacturer of Evaporative Air Coolers... Utility Gas Heating Equipment... Gaffers & Sattler and Occidental Automatic Gas Ranges

SPENCER

The Quality line of HEATING BOILERS



One of the four efficient Spencer Steel Heating Boilers which supply the fifteen buildings of the modern River Edge Apartments, River Edge, New Jersey.

- ***There is a Spencer for every building, for every fuel.***

Both cast iron and steel . . . a selection of 76 models . . . versatile, dependable, backed by more than sixty years of leadership . . . precision-engineered and manufactured to give superior, *guaranteed* service.

Write for Spencer Catalogue *today*.

SPENCER HEATER
LYCOMING-SPENCER DIVISION
WILLIAMSPORT PENNSYLVANIA

SBI

IBR

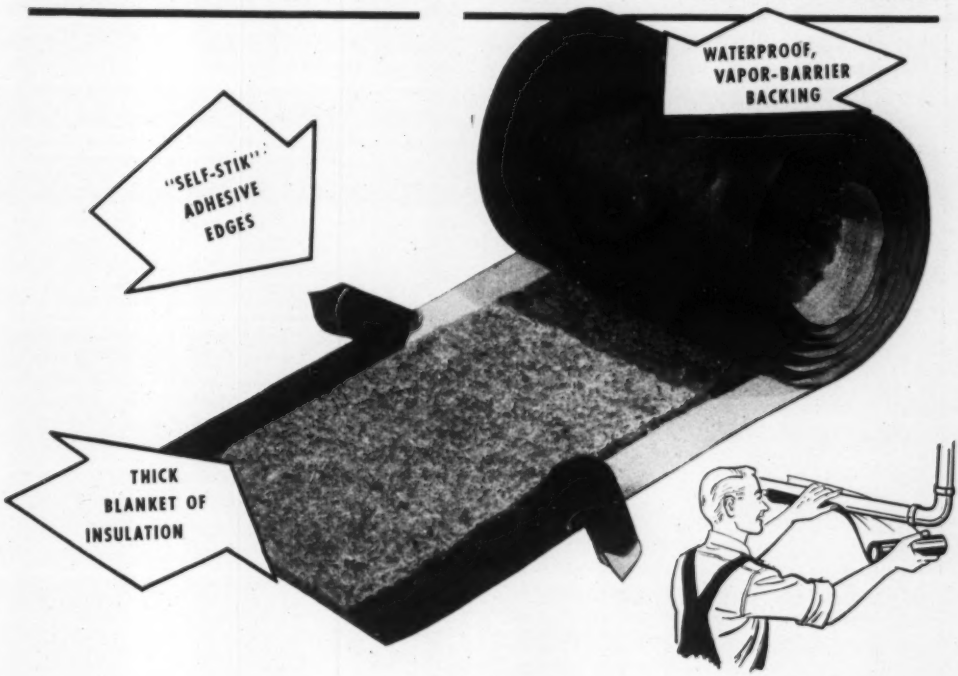
MYSTIK

Self-Stik

DRI-PIPE

INSULATION

Holds Cold and Heat • Prevents Condensation



MYSTIK DRI-PIPE—the insulation with "self-stik" edges—goes on fast, saves time and money on installation. Ideal for low-temperature applications—on cold water lines, cold air ducts, refrigeration lines. Holds temperatures, prevents condensation and dripping, eliminates icing and frosting on refrigeration lines. Also has extensive other cost-cutting insulation uses—on warm water lines, warm air ducts and for sound deadening. Ask your supplier or . . .

WRITE NOW for free sample of MYSTIK Self-Stik DRI-PIPE Insulation to Mystik Adhesive Products, 2653 N. Kildare, Chicago 39, Ill.

MYSTIK CLOTH TAPES • MYSTIK PAPER MASKING TAPES • MYSTIK SPRA-MASK • MYSTIK PROTECTO-MASK • MYSTIK SAND-BLAST

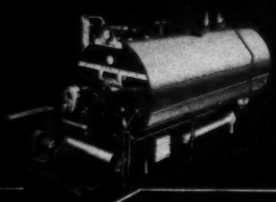
HERE'S PROOF!

Boiler rooms are
QUIETER, CLEANER, SAFER, with
SUPERIOR'S Built-in, INDUCED Draft.

Superior's Induced Draft prevents the escape of combustion gases into the boiler room . . . even through an open port. For our photo shows one of our engineers observing the fire through the wide open pressure-relief port.

It also explains one other distinct advantage of induced draft . . . the fact that the fire is pulled through each successive pass without impingement and wear on refractory as is the case under forced draft. For that relief port is at the end of the first pass where the combustion gases are turning the corner into the second pass. If they weren't being led, some of them would find their way out through the open port.

Greater quiet; longer trouble-free operation; cleaner, more healthful atmospheres are other primary results. We can't tell you the whole story here, but you'll find it all in our new catalog. Write today to reserve your copy of the newest edition. Ask for Catalog 304



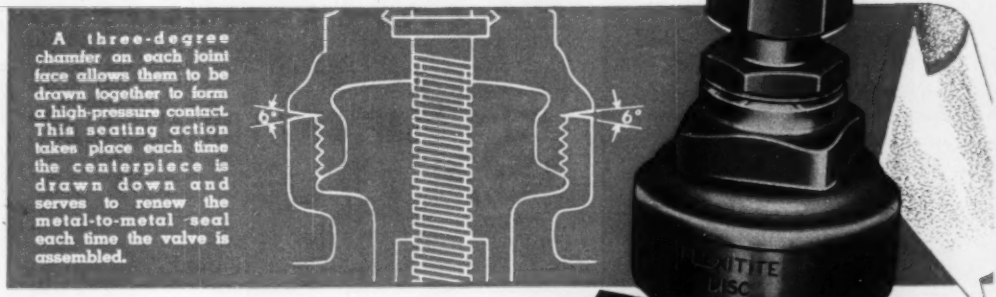
SUPERIOR COMBUSTION INDUSTRIES, INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 18, N. Y.

SUPERIOR
STEAM GENERATORS

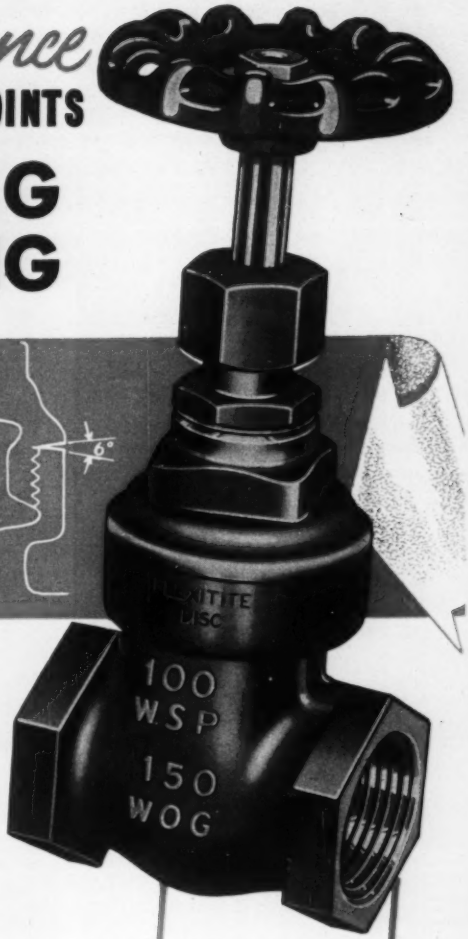
Six Degree Clearance

MAKES O-B CENTERPIECE JOINTS

SELF-SEALING NON-LEAKING



A three-degree chamfer on each joint face allows them to be drawn together to form a high-pressure contact. This seating action takes place each time the centerpiece is drawn down and serves to renew the metal-to-metal seal each time the valve is assembled.



O-B No. 25 Line Gate
100 pounds W. S. P.
150 pounds W. O. G.
Also available with solder-type pipe ends

No messy joint compound--no gaskets to fuss with. Simply turn the centerpiece snug against the valve body, and the joint is sealed tight. The chamfered faces result in a six-degree clearance at the joint (see diagram) which permits the centerpiece to be drawn down to form a high-pressure line contact. This metal-to-metal contact more effectively seals the joint against leaks than the old-fashioned method of using gaskets or joint-sealing compounds.

Designed by men who have an intimate knowledge of the plumbing and heating business, and made by a company with more than sixty years of valve manufacturing know-how, you can feel confident when you install O-B valves.

You will find a full line of low and standard pressure valves at your local Ohio Brass distributor. Call him for any of your valve needs.

OHIO BRASS CO. MANSFIELD, OHIO

Ohio Brass VALVES

BRONZE GLOBES ANGLES GATES AND CHECKS

A COMPLETE LINE

FROM 3/4" TO 3"

EXTRA capacity...

(on smaller sizes)

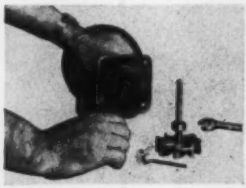
FULL 1½" CAPACITY FOR ALL SIZES
(¾", 1", 1¼" or 1½")

Taco circulators have that *extra* capacity needed for today's modern small pipe radiant heating jobs (radiators, convectors, baseboards or panels).

QUIET

no velocity noises regardless of size used!

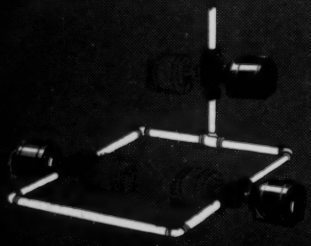
A CINCH TO SERVICE



All you need is an open end wrench, screw driver and allen set screw wrench. Taco's carbon seal runs against a stainless steel seal eliminating any wear in bracket.

Goes in small places

Fits in the low cost homes built today. Can be placed in almost any position.



LESS AND MORE FLEXIBLE INVENTORY

(on popular sizes)

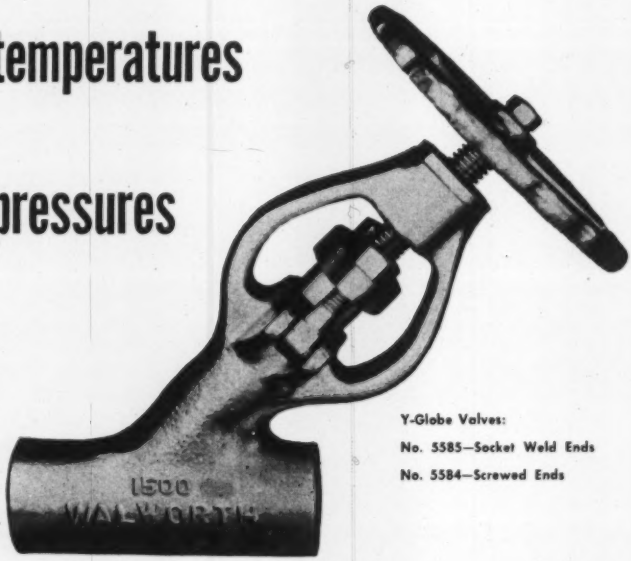
Interchangeable flanges mean one circulator plus four sets of flanges (¾", 1", 1¼" or 1½") equals four sizes of circulators in stock.

YOU CAN'T BEAT
TACO'S QUALITY STORY
Taco circulators are made from the best that money can buy.
HC
Taco

Walworth's NEW small cast steel valves

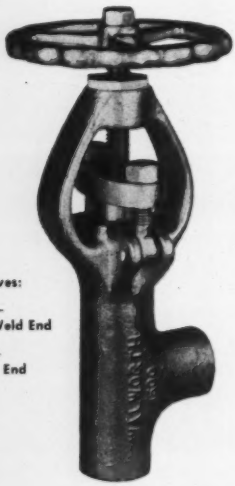
SERIES 1500 – SIZES ¼ to 2 inches

handle HIGH temperatures
HIGH pressures



Y-Globe Valves:
No. 5585—Socket Weld Ends
No. 5584—Screwed Ends

Walworth is proud to make these new Small Cast Steel Valves available to power stations . . . oil refineries . . . ships . . . wherever piping is subject to severe pressures and temperatures. Non-shock service ratings of these valves: 1500 psi–950F for steam; 3600 psi–100F for water, oil or gas. Cast of chromium molybdenum steel, they are compact and light, yet exceptionally strong. Both Y-Globe and Angle type valves are available.



Angle Valves:
No. 5587—
Socket Weld End
No. 5586—
Screwed End

Simplified Walworth design eliminates many of the valve problems encountered in high pressure service. Among the features of this new valve are:

INTEGRAL BODY AND YOKE – made from a single casting without threading or welding. Bonnet joint — always a potential source of leakage — is eliminated. Valves can be reassembled quickly and easily.

ROTATING DISC – prevents valve seat distortion and consequent leakage. Cuts down replacements.

WELDED SEAT RING – compensates for changes in pressure and temperature—eliminates a major source of leakage.

SPECIAL BACK SEAT BUSHING – permits repacking the valve under pressure with greater safety.

PACKING CHAMBER – designed to dissipate heat thus keeping packing rings at lower temperatures—gives them longer life.

These valves are available with either socket weld ends or screwed ends, in sizes ranging from ¼ to 2 inches. For further information on Walworth series 1500 Small Cast Steel Valves, see your local Walworth distributor, or write for Circular No. 134.

WALWORTH

valves • fittings • pipe wrenches

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

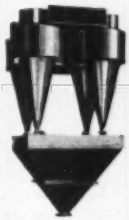
American Blower—a time-honored name in air handling

Venturafin
Unit Heaters

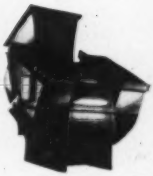
Type TM
Gyrol Fluid Drives

Utility Sets

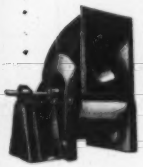
Ventura
Ventilating Fans



Dust Collectors



Mechanical
Draft Fans



Industrial Fans

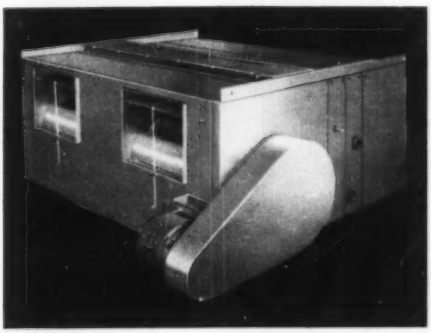
Heating and
Cooling Coils

Air Conditioning
Equipment

If you look before you buy, we're certain you'll buy American Blower Air Handling Products. There's a big difference in quality, design, quietness, operating costs and efficiency. Test after test by buyers has proved American Blower superiority.

In New York, as in other cities, American Blower Air Handling Products serve commerce, industry and public utilities. For air handling data in the New York area, call American Blower—Bryant 9-2885. In other areas, consult your phone book.

Product of the month



American Blower Heating and Ventilating Unit. 7 Sizes. Capacities from 1,000 to 15,000 cfm and 45,000 to 976,000 Btu/hr.

Prepare now for winter comfort

Now is the time to make your plans for winter heating. And we'd like to suggest that you include American Blower Heating and Ventilating Units in these plans.

Engineered to provide efficient, comfortable heating in offices, auditoriums, gymnasiums, laboratories, lobbies, schools, stores and similar applications, users find these dependable units an unusually profitable investment.

They are available in seven sizes, for wall, horizontal, inverted and floor installation. Humidifiers, face and by-pass dampers, filter boxes and mixing boxes are available for complete winter comfort conditions. Each fan housing is equipped with an American Blower Aileron to control the flow of air from the slow speed centrifugal fans.

Investigate the many advantages of American Blower Heating and Ventilating Units. For additional information, call your local American Blower Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

YOUR BEST BUY AMERICAN BLOWER AIR HANDLING EQUIPMENT

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

1931

. . . with a background of twenty years

1951

PHOTO BY EZRA STOLLER

THE AUSTIN COMPANY, ENGINEERS AND BUILDERS

For over 20 years The Upjohn Company, Kalamazoo, Michigan has been a continuous user of ILLINOIS Automatic Steam and Fluid Control Equipment as an integral part of its air conditioning and vacuum heating systems and process control.

ILLINOIS Specialties meet fully the exacting requirements of this, "The World's Largest Industrial Air Conditioning Project".

120 separate air conditioning systems in this new unit handle 2,800,000 cfm.

Western Michigan Representative: **Marshall & Wells Company, Grand Rapids**

ILLINOIS ENGINEERING COMPANY
INCORPORATED 1900
RACINE AVENUE AT 21ST STREET • CHICAGO 8

B&G SERIES 1522 *Hydro-Flo* CENTRIFUGAL PUMP

The B & G Leak-proof Seal alone establishes this pump as the "buy" for your cooling tower or evaporative condenser installations. The Seal is self-lubricating and eliminates the usual leakage through the packing gland—assures long, trouble-free service.

It's a *quiet* pump. Long bronze sleeve bearings hold the shaft in alignment and the spring-type flexible coupling helps keep noise at a minimum. The impeller is *hydraulically balanced* . . . highly efficient.

Bearing bracket sub-assembly, including shaft and sleeve bearings, is interchangeable in all B & G 1522 Pumps. Easily serviced—the pump separates into three parts.

The B & G 1522 is available in all-iron, bronze-fitted, all-bronze or stainless steel units.

A GREAT COMBINATION
FOR MORE EFFICIENT REFRIGERATION INSTALLATIONS

B & G Direct Expansion Evaporators are constructed according to U-69 Code of ASME regulations.

B & G *Hydro-Flo* EVAPORATORS

Unique design prevents oil-trapping in head passes

A certain amount of compressor crankcase oil is picked up by the refrigerant during compression. If oil is continuously trapped in the evaporator, the oil in the compressor crankcase becomes depleted, which may cause bearing trouble. If the condition is not corrected, the system eventually becomes useless, for excessive oil in the evaporator reduces heat transfer.

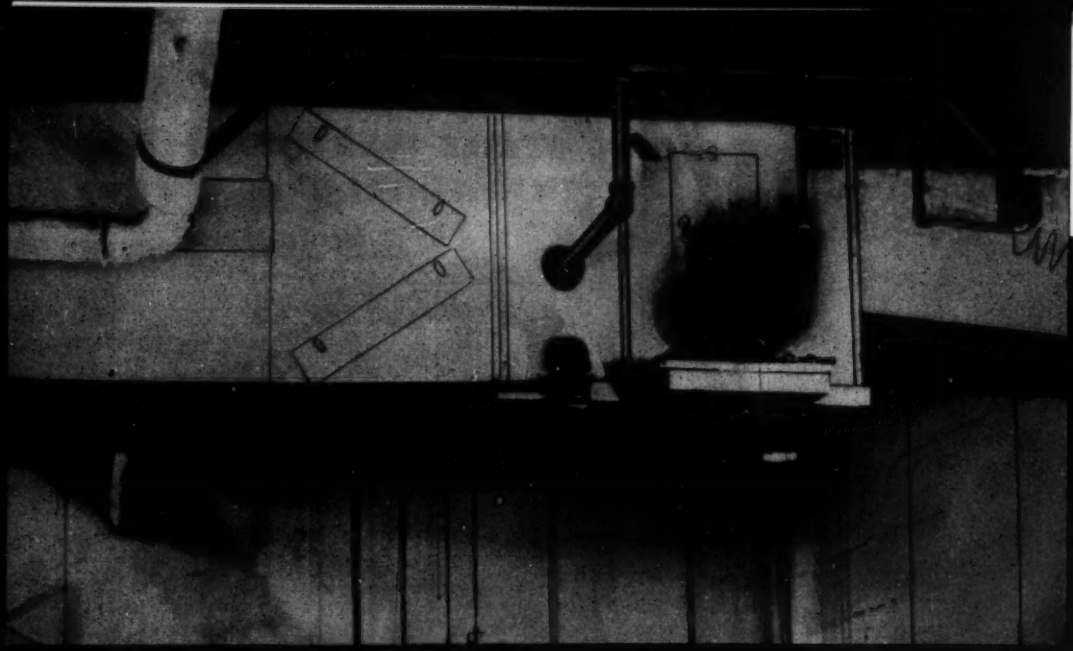
The diagram at left shows how this trouble is prevented in the B & G Evaporator. Note that the lower tube in pass "B" leading to pass "C," and the lower tube in pass "C" leading to pass "D" are located very close to the baffle plate, permitting any oil entering passes to travel freely with the Freon vapor back to compressor. *There is no step-up or sump to trap oil!*

Send for engineering data on B & G Evaporators, Condensers and Centrifugal Pumps.

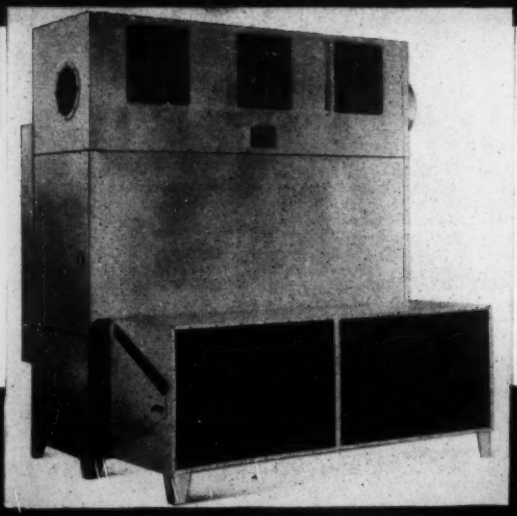
BELL & GOSSETT
C O M P A N Y

Dept. RCC-5, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada *Reg. U. S. Pat. Off.



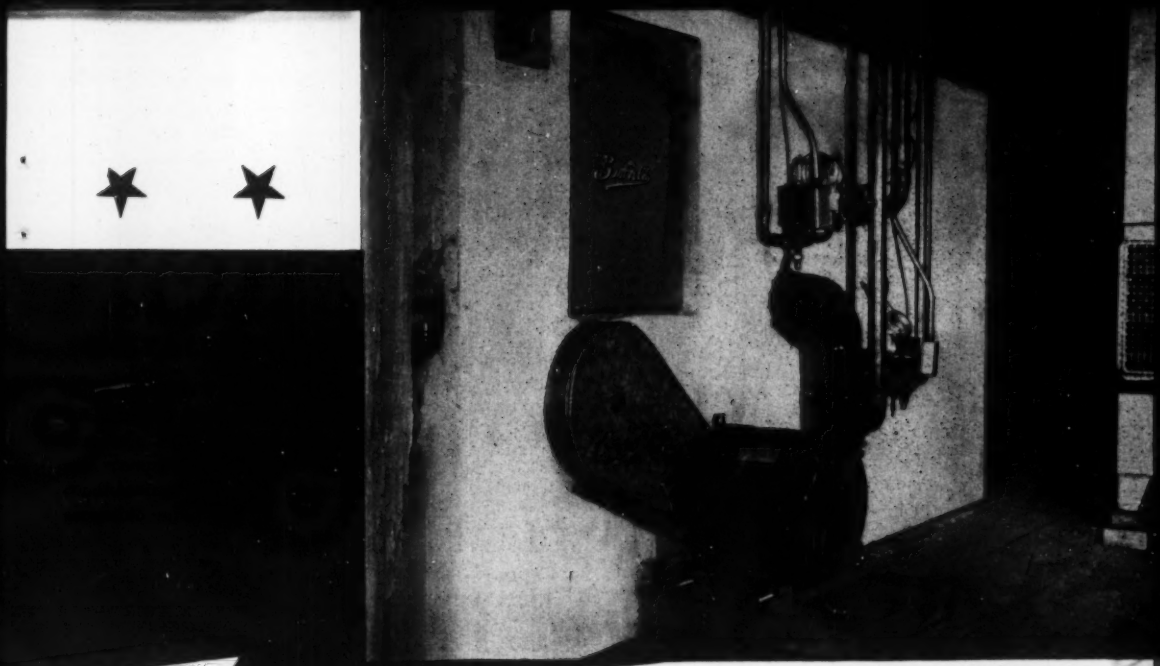
These "Buffalo" CABINETS



NO KNOCKING OUT WALLS

to bring this "Buffalo" VPC (vertical model) Cabinet into your plant. In 3 interchangeable sections, it can pass easily through standard doorways. This makes for simplified maintenance, too. Quality construction throughout includes heavy paneling and hollow shaft fans.

HEATING • COOLING

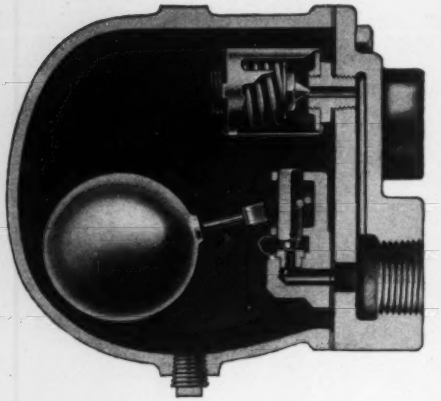


ARE SPACE-ECONOMIZERS!

FOR LONGER SERVICE AND BEST RESULTS

figure sturdy, efficient "Buffalo" Central Air Conditioning Cabinets in your plans. Central conditioning—one unit for a building, rather than many small units — is far cheaper and more satisfactory in the long run. LET US MAIL YOU BULLETIN 3703, FOR YOUR FILES.

AIR CONDITIONING UNITS



COMMON SENSE approach to

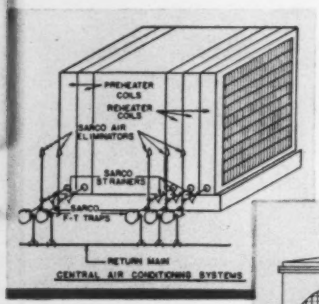
TRAP SELECTION FOR UNIT HEATERS

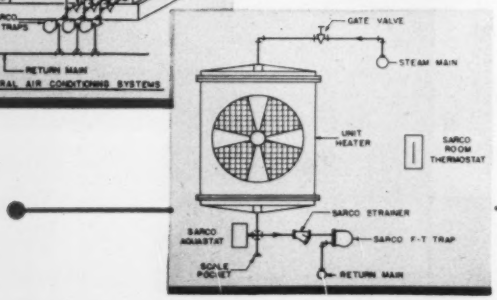
what are the requirements for efficient unit heater or blast heater drainage?

1. High starting load capacity to deal with cold air and low steam pressure resulting from peak load.
2. Free discharge of incondensables on starting and during running.
3. Continuous condensate discharge to prevent hot and cold air blasts.
4. Release of condensate at or near steam temperature.

why is the Sarco type F.T. the ideal steam trap for such heaters?

1. The float operated main valve can be sized to handle the condensate loads from the lowest pressures up to maximum design pressure.
2. The built-in air vent prevents air binding under starting or running conditions.
3. Sarco F.T. traps discharge condensate continuously, as soon as it forms—don't need to cool or to wait until steam leaks out of buckets before they fill and discharge.
4. The float level and, therefore, the valve opening is controlled by the rate of condensate flow into the trap. On no load, the valve is closed.

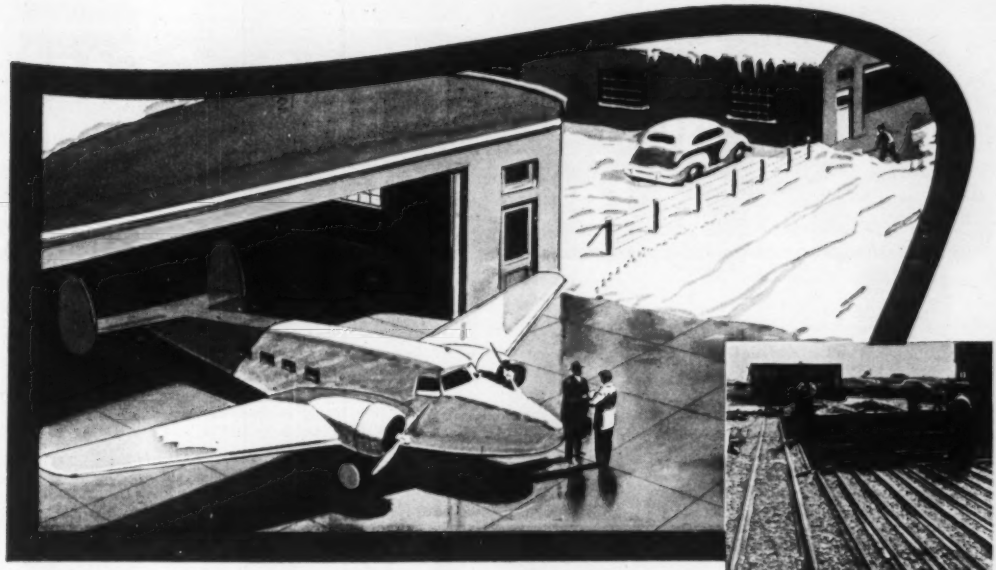




New Bulletin 455 contains full information on latest improvements.

SARCO COMPANY, INC.
EMPIRE STATE BUILDING, NEW YORK 1, N. Y.
Represented in Principal Cities
SARCO CANADA LTD., TORONTO 5, ONTARIO

335



The snow-shoveling system has changed... but the name on the pipe is an old one...

SPANG CW

Shoveling snow is slow, inconvenient, and labor-consuming. But the owner of an underground snow-melting system gets rid of snow as fast as it falls, merely by opening a valve.

When you're installing a snow-melting system, specify "Spang CW Steel Pipe" . . . the ideal economical pipe for all closed heating systems. It's equally good under asphalt or concrete, and lasts for years in any location.

Your men will like the way Spang CW Steel Pipe fits up . . . it bends easily and smoothly, is easy to cut and weld. And its uniform high-quality assures good, tight installations.

Specify "Spang CW Steel Pipe", the brand that's backed by our 110 years of pipe-making experience.

There's a supply house near you carrying Spang Pipe and a full line of fittings and equipment for snow-melting and radiant-heating systems. They are making every effort to meet today's great demand for Spang CW Pipe quickly and fairly.

SPANG - CHALFANT

Division of The National Supply Company

GENERAL SALES OFFICE: Grant Bldg., Pittsburgh, Pa.

District Sales Offices: Atlanta; Boston; Detroit; Houston; Los Angeles; New York; Philadelphia; Pittsburgh; St. Louis

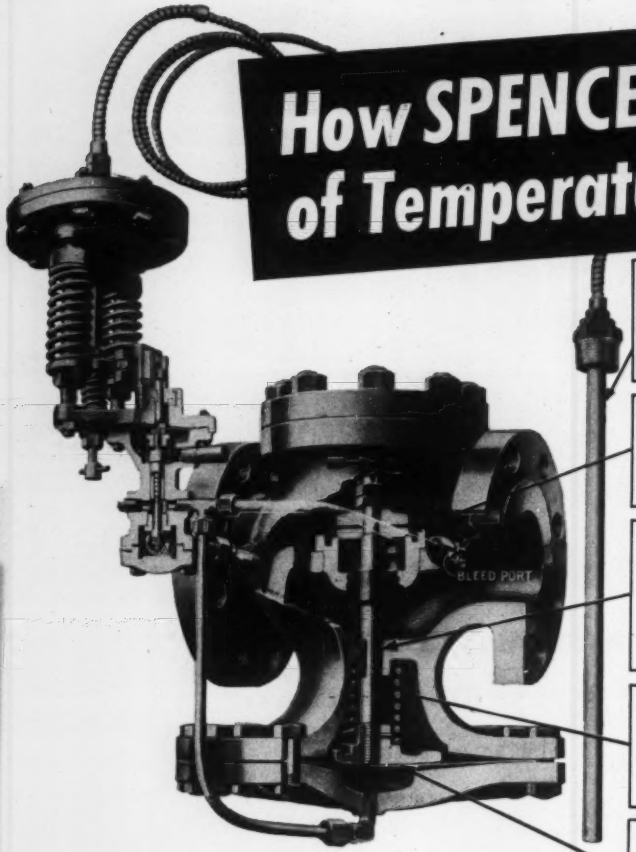
SPANG

STEEL PIPE

QUALITY

that is recognized wherever pipe is used

How SPENCE Cuts Costs of Temperature Control



NEW THERMOSTAT ELEMENT—Improved to practically eliminate loss of filling. Rugged construction; cannot be injured by overheating.

SECO METAL—Seats and discs are made of SECO Metal—guaranteed not to wire-draw.

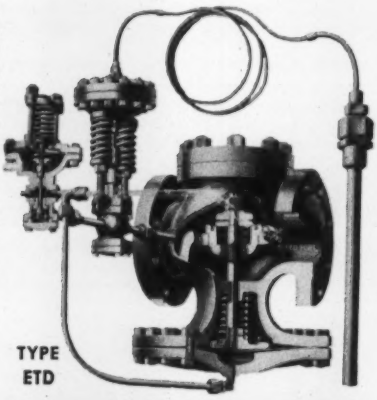
PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

PROTECTED SPRINGS — Springs in the Spence Regulator are out of the path of the steam or other fluid flowing through the valve.

LARGE BALANCED DIAPHRAGM— Spence metal diaphragms, under usual conditions, never require replacement.

Accurate Control for Both Storage and Instantaneous Heaters

Spence Temperature Regulators reduce the steam pressure and also accurately modulate the flow as required to control the temperature. No separate reducing valve is necessary • The Spence ET150 Regulator is recommended for heater pressures up to 50 psi. For higher pressures the Type ETD is available • For complete details on the entire Spence line of automatic regulating valves, strainers and desuperheaters, write for Bulletin 1200.



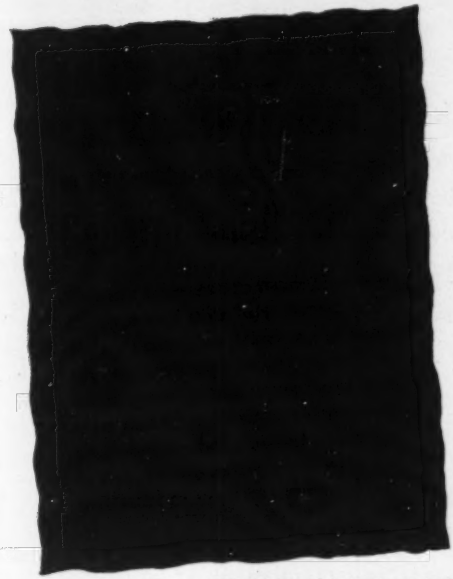
TYPE ETD

SK 111

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

BRUNNER
SINCE 1906



BRUNNER offers YOU Air Conditioning and Refrigeration Condensing Units up to 75 tons capacity, incorporating design features providing maximum adaptability to specific application requirements.

BRUNNER offers YOU an experienced engineering staff qualified to assist in working out problems of selection, installation and operation.

BRUNNER offers YOU plant capacity and manufacturing flexibility enabling you to meet delivery as well as equipment specifications.

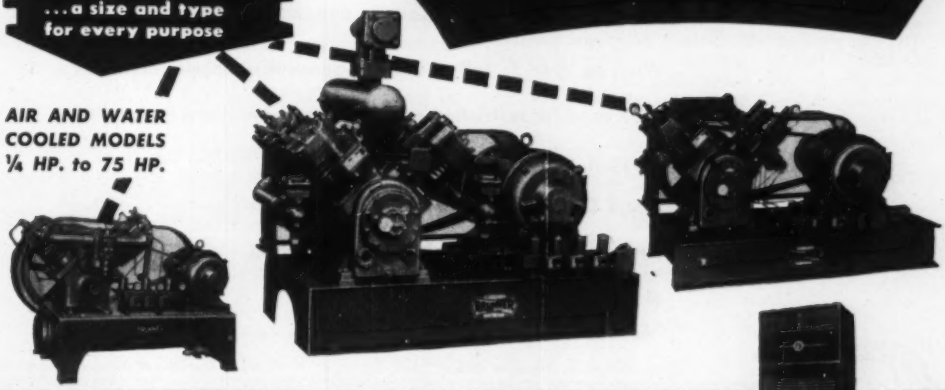
BRUNNER offers YOU not only a complete range of dependable equipment but a well known, highly respected organization working hand in glove *for* you toward the satisfying and profitable fulfillment of your contracts.

BRUNNER MANUFACTURING COMPANY, UTICA 1, N. Y., U. S. A.

Write or phone us for a factory representative who can talk your language, from preparing bids to making the installation. No obligation.

REFRIGERATION CONDENSING UNITS
...a size and type for every purpose

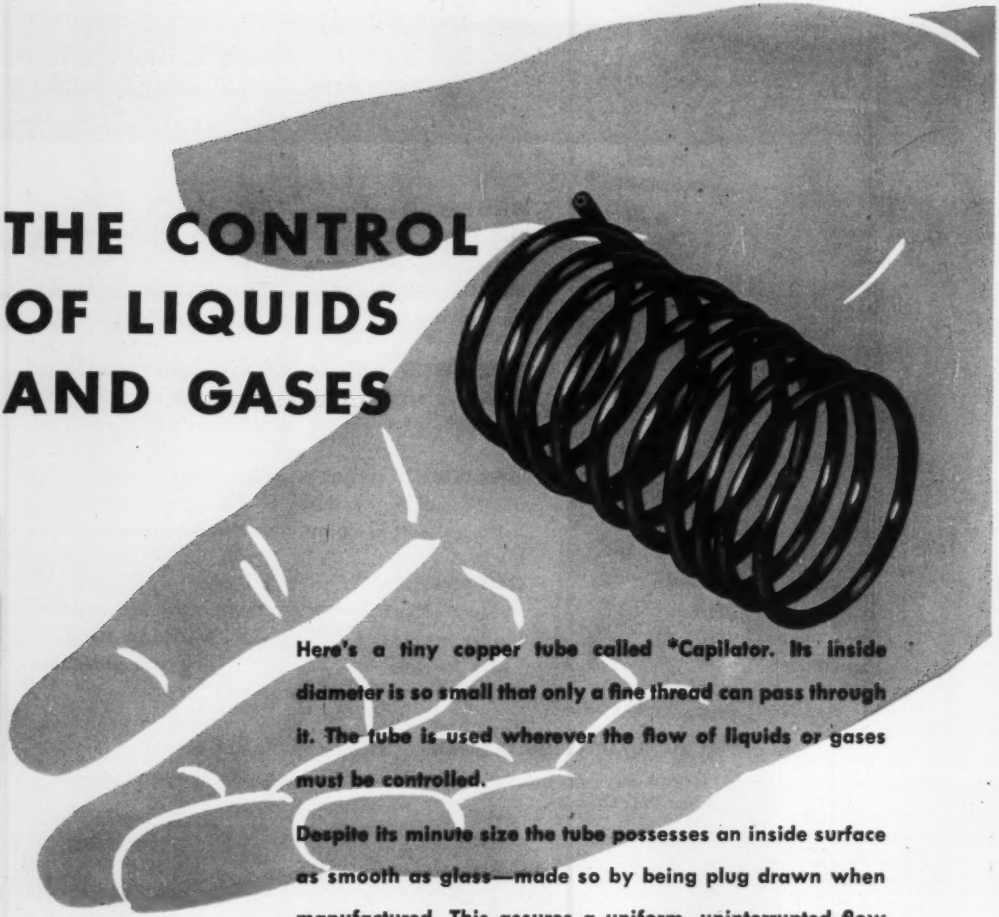
AIR AND WATER COOLED MODELS
¼ HP. to 75 HP.



BRUNNER
SINCE 1906

AIR CONDITIONING
Self Contained Units in 4 sizes: 3-5-7½ and 10 HP.
Remote Installation Types from 3 to 75 HP.

THE CONTROL OF LIQUIDS AND GASES



Here's a tiny copper tube called *Capilator. Its inside diameter is so small that only a fine thread can pass through it. The tube is used wherever the flow of liquids or gases must be controlled.

Despite its minute size the tube possesses an inside surface as smooth as glass—made so by being plug drawn when manufactured. This assures a uniform, uninterrupted flow through the tube and results in dependable operation.

We'll be glad to tell you more about this unique capillary tube used for restriction purposes and how it can be applied to your controls. WOLVERINE TUBE DIVISION, Calumet & Hecla Consolidated Copper Company, Incorporated, *Manufacturers of Seamless, Non-Ferrous Tubing,* 1419 CENTRAL AVENUE, DETROIT 9, MICHIGAN.

**Reg. U.S. Pat. Off.*

Sales Offices in Principal Cities *Plants in Detroit, Mich. and Decatur, Ala.*

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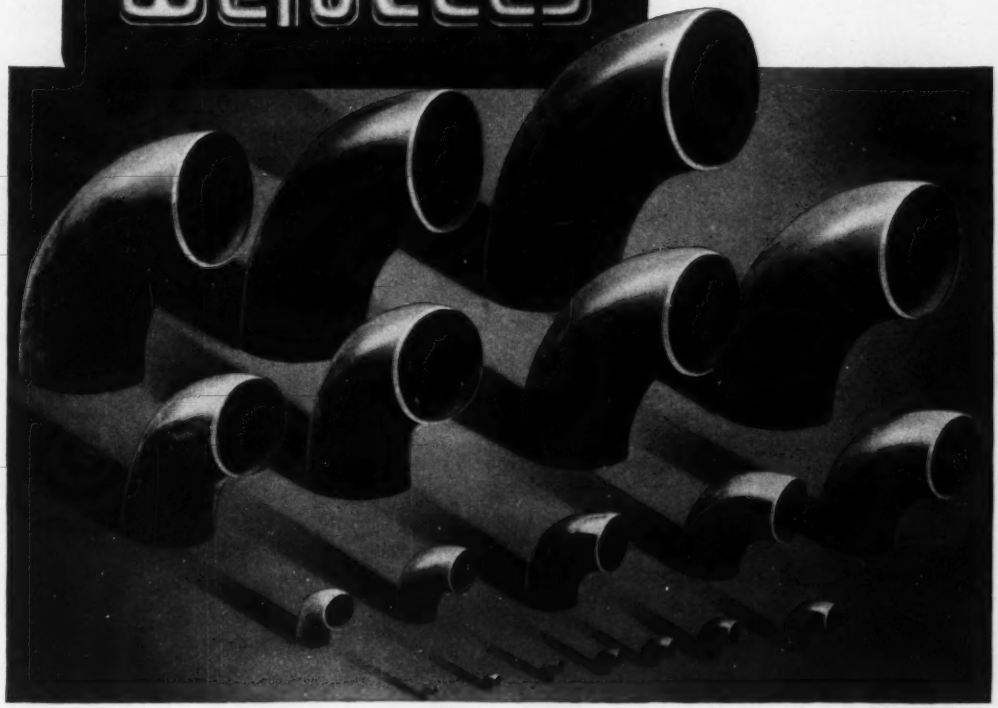
Export Department, 13 E. 40th St., New York 16, N.Y.

WeldELLS®



Just a Corner of the World's Largest Line

Illustrated above are the stock sizes of long-radius WeldELLS in a single weight and material. Multiply this group by all the weights, all the types and all the materials, and you have the world's largest line of forged fittings for pipe welding.

The Taylor Forge line grew to this size because nothing less could meet the demand for fittings of Taylor Forge design, quality, accuracy, uniformity.

Make this your final reason for insisting on the WeldELL line for every fitting and flange requirement. Coupon brings new data sheet described below.

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TAYLOR FORGE & PIPE WORKS • General Offices and Works: P. O. Box 485, Chicago 90, Ill.
Offices in all principal cities • Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont. Canada

TF

A volume of data on a single sheet

Data on welding fittings and flanges condensed on two sides of a durable, varnished, letter-size card. Particularly useful for the pipe designer. Coupon brings your copy.

Send one of your fitting and flange sheets to:

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POSITION_____

COMPANY_____

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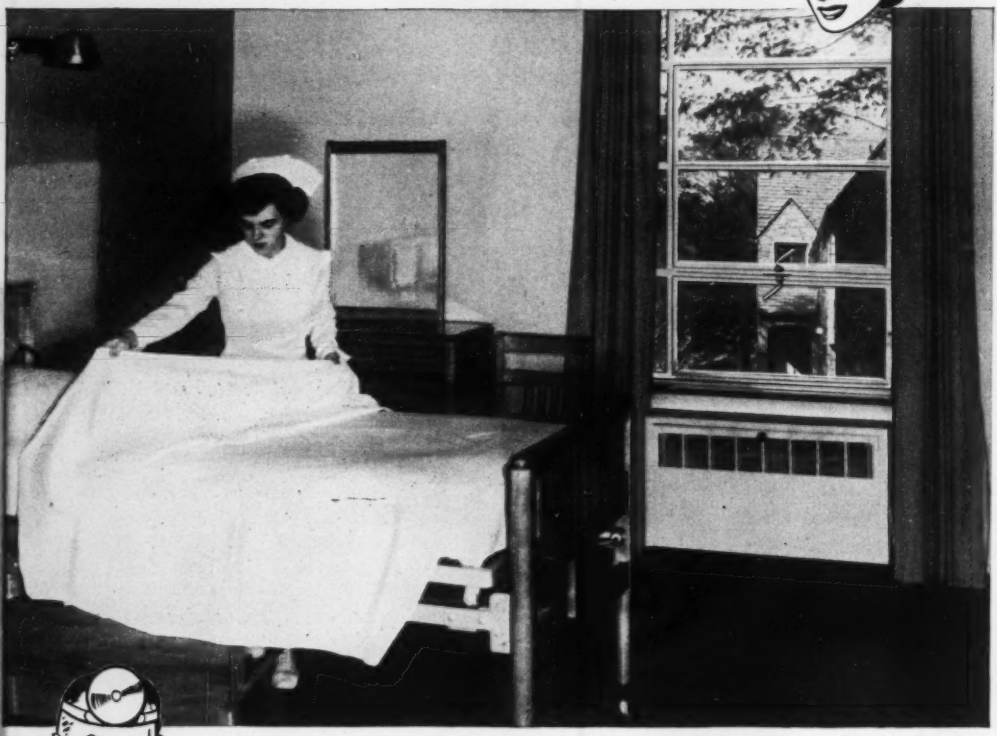
CITY_____ ZONE____ STATE_____

510-0751 Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.

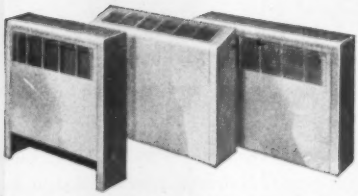
CHOOSE SMARTLY-STYLED MODINE CONVECTORS

FOR EFFICIENT, LOW-COST HEATING



You get uniform, floor-to-ceiling heat —*when you want it*— with Modine Convectors. Modines give you all the advantages of steam or hot water heating — plus worth-while savings on installation, fuel and maintenance.

Beautifully designed Modine Convectors fit in perfectly with any decorative treatment. And remember, Modines can be installed as free-standing units — or recessed in the walls to conserve space.



FOR HOSPITAL INSTALLATION

Type IF with upper grille and choice of lower opening or lower grille—for either recessed or free-standing installation. Type IS and IW for wall placement. Dampers for all enclosures optional at slight extra cost. *For information regarding other types of installations, see your Modine dealer, or write direct.*

Modine

CONVECTORS

Modine Mfg. Co., 1509 DeKoven Ave., Racine, Wisconsin

R-1106

Send for new Modine convector catalog today

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Teflon*

V-RING PACKING CONVERSION KIT

A *Complete*

PACKAGED UNIT

This complete packaged Fisher Teflon V-Ring Conversion Kit converts a standard Fisher stuffing box unit to Fisher Teflon V-Ring Packing. It offers prompt service, guarantees a true fit and insures damage-free delivery.

When ordering, be sure to furnish the valve serial number found stamped on the patent plate attached to yoke or body.

* Teflon is the trade name of E. I. DuPont de Nemours & Co.

FISHER GOVERNOR COMPANY
Marshalltown, Iowa

Fisher Teflon V-Ring Packing is furnished as standard on new Fisher Diaphragm Motor Valves.

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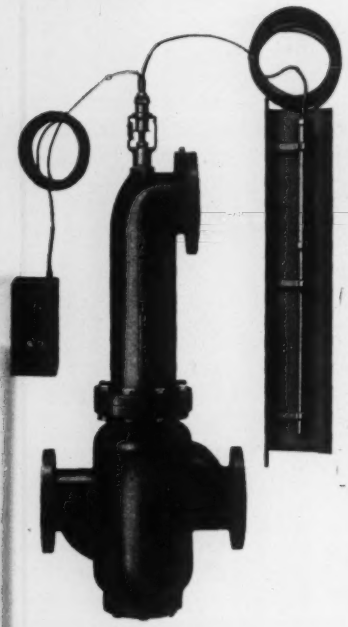
WORLD LEADER IN THE MANUFACTURE OF PRESSURE REGULATORS AND IN RESEARCH FOR BETTER PRESSURE CONTROL

It's Here!

THE IMPROVED MODULATING CONTROL for Hot Water and Radiant HEATING SYSTEMS . . . .

a good product made better



Sarcotherm engineers are constantly searching for a better product.

While utmost simplicity is still the dominant design principle, the new models now available show many important improvements and refinements.

Double Seated Valves are now used in the larger sizes, greatly increasing valve capacity and permitting smaller valves being used on a given size job. *Convenient manual adjustment* features are now provided in a variety of combinations. *Program control systems* are available to meet any specification.

Easy Installation. New body construction simplifies piping and allows for easy servicing.

Hundreds of successful installations testify to the efficiency of this simple system. Our Engineering Department will be glad to recommend a suitable control system for your particular job.

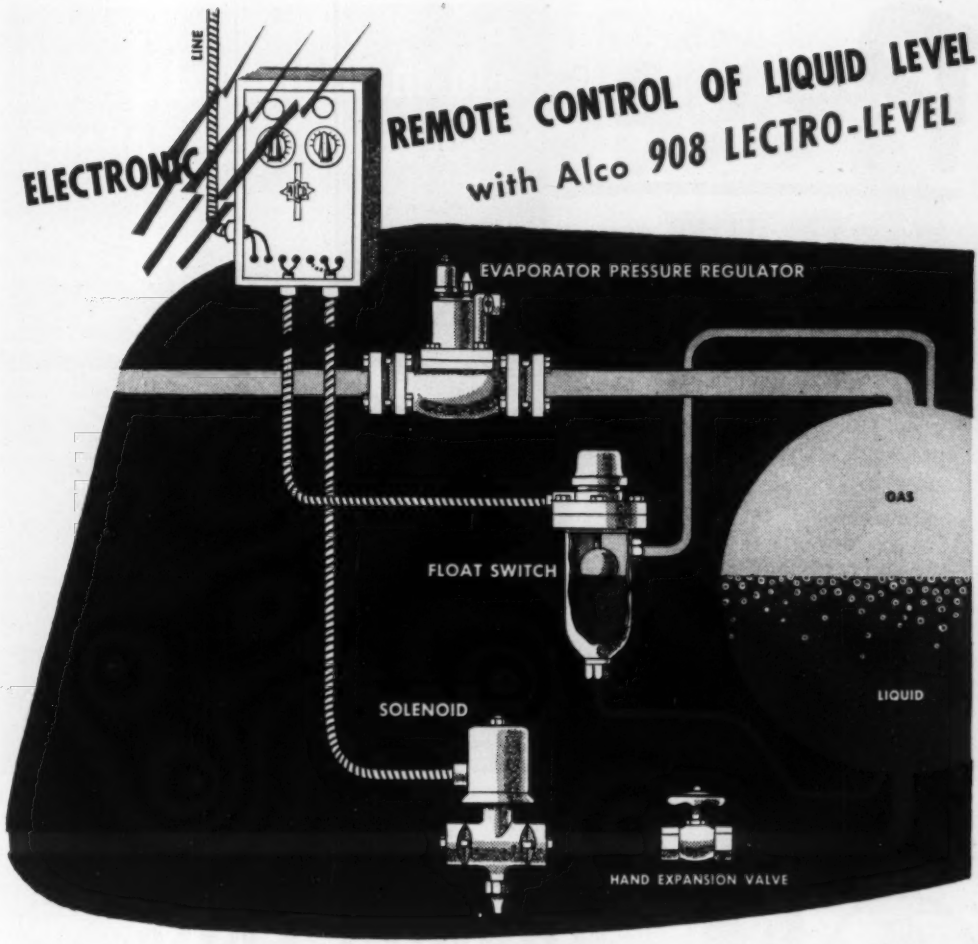
Ask for new Bulletin ST-501 describing latest improvements.

19

Sarcotherm

SARCOTHERM CONTROLS, INC. • Empire State Bldg. • NEW YORK 1, N. Y.

ELECTRONIC REMOTE CONTROL OF LIQUID LEVEL with Alco 908 LECTRO-LEVEL



Accurate liquid level control for:

- full-flooded evaporators
- shell and tube coolers

FLEXIBLE—adjustable to a wide range of level changes due to load variation

REMOTE CONTROL—easy to set-control dials mounted conveniently in remote box

TIME-PROVEN—Lectro-Level has been successfully employed on critically flooded evaporators throughout the country for over *5 years*

We will be glad to send you complete technical and installation information. Write for Bulletin 908 or see your ALCO wholesaler.

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Designers and Manufacturers of Thermostatic Expansion Valves; Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

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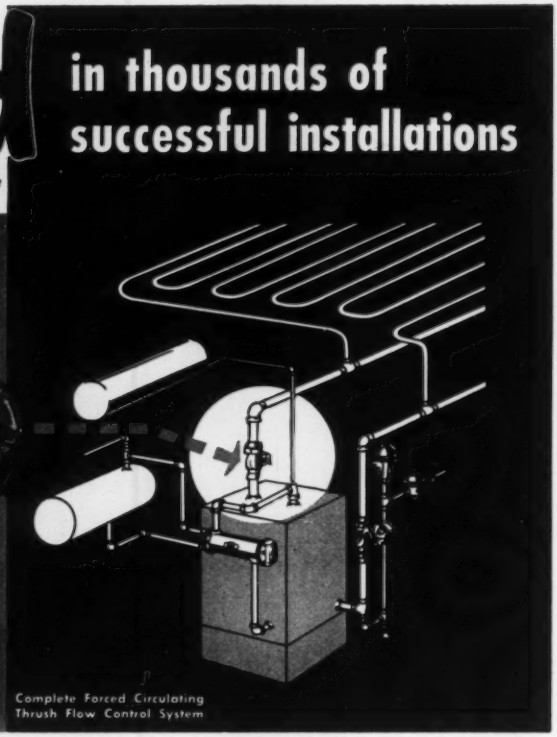
Proved in thousands of successful installations

No. 201 Thrush Radiant Heat Control

No. 200 Relay Transformer

Horizontal Thrush Water Circulator



Complete Forced Circulating Thrush Flow Control System

FORCED CIRCULATING FLOW CONTROL HOT WATER HEAT

Keeps air out of Radiant Coils...

RADIATORS, BASEBOARD AND CONVECTORS

KEEP HOT water heating systems operating at the peak of efficiency by eliminating air at its source. The improved Thrush Flow Control Valve vents air from the boiler. It is really two valves for the price of one because it provides both flow control and air elimination without any extra air tube fitting. Made in the vertical type shown here and also in the angle type to facilitate ease of installation under varying conditions. No other flow control valve has all these features. If you want to give your customers the best in modern radiant hot water heat, specify Thrush Forced Circulating Flow Control System with these valves.

Ask your wholesaler or write Dept. E-7 for bulletin.

H.A. Thrush AND COMPANY
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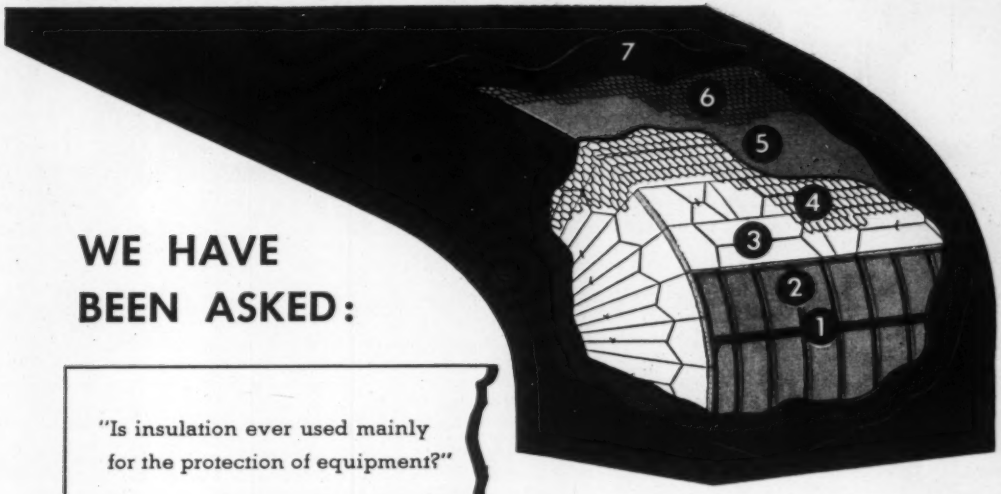


WE HAVE BEEN ASKED:

"Is insulation ever used mainly for the protection of equipment?"

"I've always thought of insulation as a means of conserving heat or refrigeration," writes a student engineer. "Is it worth the expenditure to use insulation mainly as protection for equipment?"

We answered the question by writing that we have come across quite a few cases where the main purpose of insulation was not to save heat or cold, but to save the equipment itself. For example, at many modern steam generating plants you'll find insulation on the outdoor metal breechings carrying waste gases to the stacks. While the insulation improves draft and efficiency, its main purpose here is to eliminate internal corrosion.

Although the gases are usually at high temperatures, some of the corrosive combustion products will reach their dew points when the gases contact the cooler metal surfaces of an uninsulated breeching. Condensation occurs, and a corrosive liquid is deposited on the interior surfaces. To minimize this condensation, insulation is applied to keep the breeching at a temperature above the corrosive components' dew points.

Because no completely satisfactory coating has been found to protect the outer surfaces of the metal, the insulation, when it is thoroughly weatherproofed, also protects the outside of the breeching against rust, fumes, and other causes of deterioration.

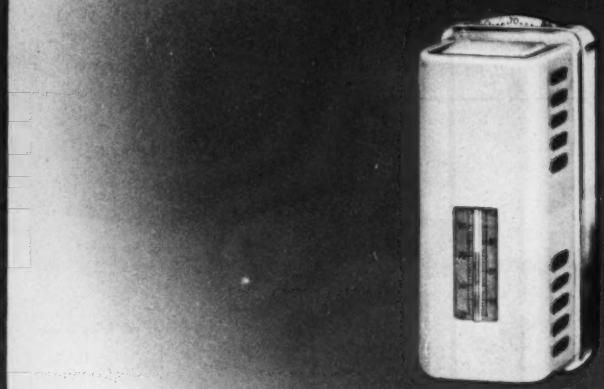
1. Transverse stiffeners on breechings;
2. ¼" pencil rods welded on;
3. 1" thick 85% Magnesia wired in place;
4. 2" mesh hexagonal wire netting wired to blocks;
5. Asbestos cement ½" thick (2 coats);
6. 1" mesh hexagonal wire netting;
7. Armstrong's Insulmastic (2 coats).

Method of insulating breeching used by large generating station. Main purpose: protection of metal.

Advising when insulation should be used, as well as how it should be put up, is part of the service offered by Armstrong. Armstrong maintains a contracting organization to provide a complete insulation service—including top-quality materials and trained men to apply them.

SEND US YOUR QUESTIONS: If you have any questions on the use or application of either high- or low-temperature insulation, please do not hesitate to write to us. We'll do our best to give you a practical answer. Just address a letter or post card to Armstrong Cork Co., 4407 Maple St., Lancaster, Penna.

ARMSTRONG'S INDUSTRIAL INSULATIONS



Line-Voltage Thermostats

Unequaled for handling the heavy-duty service demanded of line-voltage thermostats. These controls have close differentials and are available for heating and air-conditioning applications. One of many in the comprehensive line of White-Rodgers automatic controls for heating and air-conditioning. *Write for catalog.*

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WR *Controls* FOR REFRIGERATION HEATING AND AIR CONDITIONING

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NEW YORK CLEVELAND CHICAGO

Resident Sales Engineers in all Principal Cities

on big jobs like this

(and small ones, too)

back up your workmanship with high-quality

U·S·S GALVANIZED STEEL SHEETS

Satisfactory ductwork installations, regardless of their size, require two things—good workmanship and top-quality materials. You can't do a good job without both. In U·S·S Galvanized Steel Sheets, you have a material that backs up the skill of your workmen in every respect.

Its fine fabricating qualities . . . its superior ability to stand up in service . . . are a matter of record.

As a result, a job done with U·S·S Galvanized Steel Sheets has more than clean, neat appearance to recommend it. Long life and superior resistance to corrosion are inseparable benefits of such installations that assure customer satisfaction and build more business for you.

IRON AND STEEL
SCRAP is a
VITAL DEFENSE MATERIAL
LET'S GET IT TO THE MILLS
IT MEANS MONEY FOR YOU
MORE STEEL FOR AMERICA

Thousands of feet of U·S·S Galvanized Steel Sheets go into the heating and air conditioning ductwork of this large office building.

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USS GALVANIZED STEEL SHEETS

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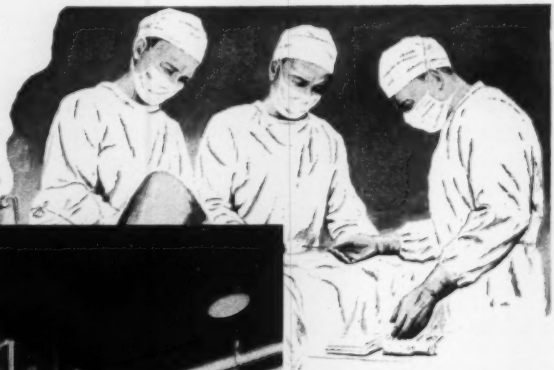
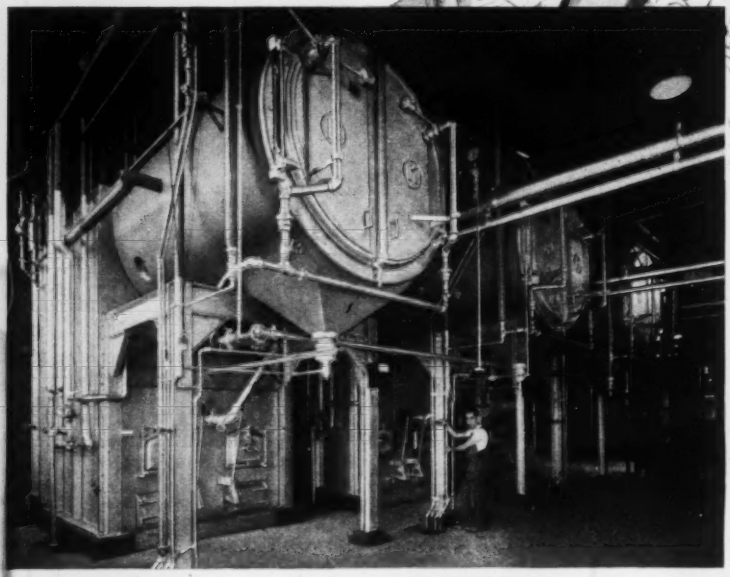
UNITED STATES STEEL

WHERE DEPENDABLE HEAT IS VITAL...





In a modern central heating plant at St. Mary's Hospital, LaSalle, Ill.; three KEWANEE Hi-Test Boilers are capable of producing 18 million Btu hourly.

Operated at 125 lbs. these boilers furnish heat for the hospital *and also power* for the laundry, kitchen, sterilization equipment and other hospital needs.

One boiler supplies steam for all operations in mild weather. The third is used as a "stand-by."

YOU'LL FIND KEWANEE STEEL BOILERS

UNUSUAL DEPENDABILITY... plus an efficiency which produces steam most economically... makes Kewanee Boilers the first choice for hospitals, schools and other important institutions. Regardless of the method employed for distributing heat, a sound system starts with a good boiler. Make sure when you build or modernize ... specify KEWANEE.

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Century MOTORS

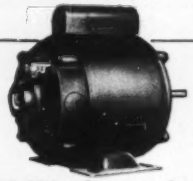
Choose From These Many Types to Fit Your Job

HEAVY-DUTY for Industrial and Appliance Use

From Century's wide range of types and sizes, there's a proper motor for all popular applications. You can be confident that the right Century motor will assure a long life of satisfactory performance.

Century Electric Company is celebrating its 50th year in the electrical industry.

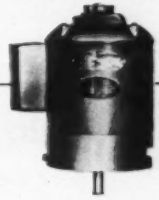
Shown here are examples of Century's line of FRACTIONAL HORSEPOWER motors—ruggedly built for smooth, quiet operation, with a remarkable freedom from vibration



TYPE CSH — Capacitor Start Induction Single Phase Motor suitable where high starting torque and normal starting current is satisfactory.

TYPE SP — Split Phase Induction, Rigid Base, Single Phase Motors suitable for light starting duty.

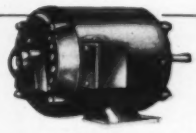
TYPE SC — Squirrel Cage Polyphase Motor built in fractional sizes for all torque requirements.



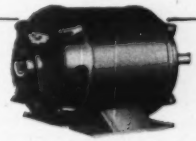
JET PUMP MOTOR—Capacitor Start Single Phase Motor available in sizes for practically every jet pump application.

TYPE SP — Split Phase Induction, Cushion Base, for quiet operation.

OIL BURNER MOTOR especially designed for this service. Compact, rugged, smooth, quiet starting and running.



TYPE RS — Repulsion Start Induction Single Phase Brush Lifting Motor suitable for applications requiring high starting torque and low starting current.



TYPE DM — Direct Current built in sizes and ratings for applications where direct current is available or its use desirable.

UNIT HEATER MOTOR provides smooth, quiet performance throughout a long service life.

GEAR MOTOR, compact, rugged, ball bearing equipped, for your high torque, slow speed requirements.

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Specify Century motors for all your electric power requirements.

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OFFICES AND STOCK POINTS IN PRINCIPAL CITIES

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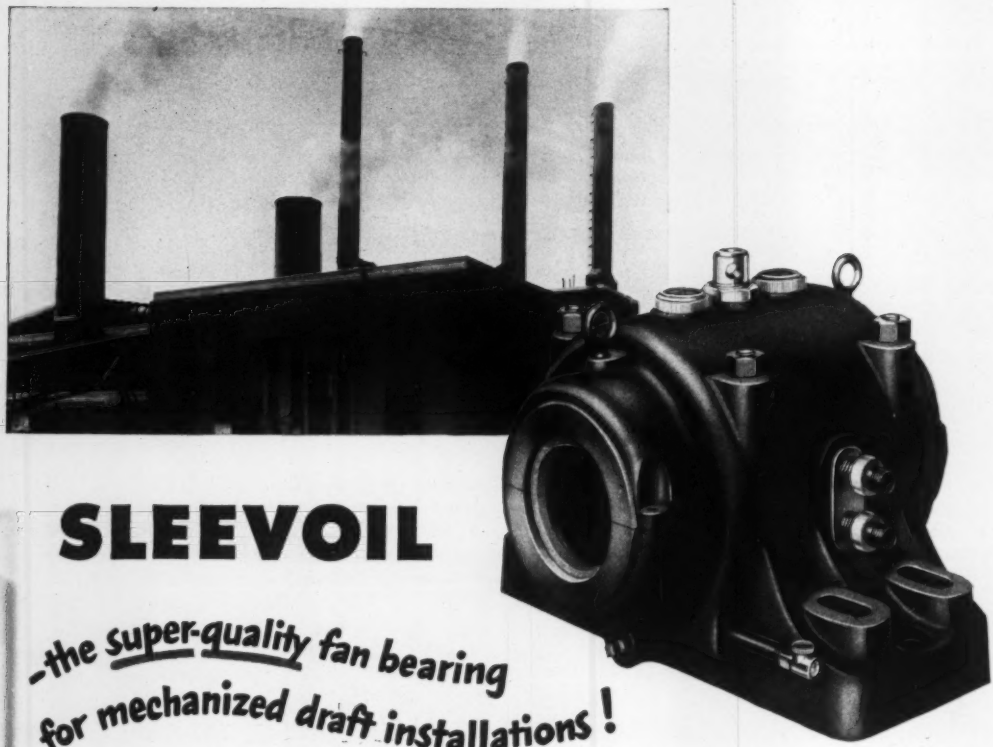

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—the super-quality fan bearing for mechanized draft installations!

● Hundreds of generating plants in America run on Dodge Sleevoil Bearings. These famous bearings combine quietness, long life and dependability to a degree unique in the bearing field. They offer engineers of costly power plants a priceless safeguard for their equipment.

Sleevoil Bearings are a Dodge development—created especially to meet the exacting requirements of fan and blower service. They are ideal bearings for important installations calling for induced or forced draft. Designed in cooperation with engineers of leading fan and blower manufacturers, they have a long record of dependable performance in critical service.

Dodge Sleevoil Pillow Blocks are normally available from stock—in both plain and water-cooled types, in shaft sizes from 1-7/16" to 8". Write us for information.

DODGE MANUFACTURING CORPORATION
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DODGE
of Mishawaka, Ind.

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on *modern* power transmission machinery for *modern* installations. Look for his name under "Power Transmission Equipment" in your local classified phone book.

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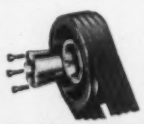

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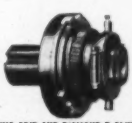


ROLLING GRIP AND DIAMOND D CLUTCHES

FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY, CHICAGO THRIFT-ETCHING CORPORATION, 1555 SHEFFIELD AVENUE, CHICAGO 22, ILLINOIS

PRODUCE MORE WITH YARWAYS...

Is higher production your aim?

Then Yarway is your steam trap. Best steam trap performance requires condensate drainage *plus*—

1. **Air and gas removal.**
2. **Velocity scrubbing of condensate from heat transfer surfaces.**
3. **Keeping highest average temperature in the equipment.**

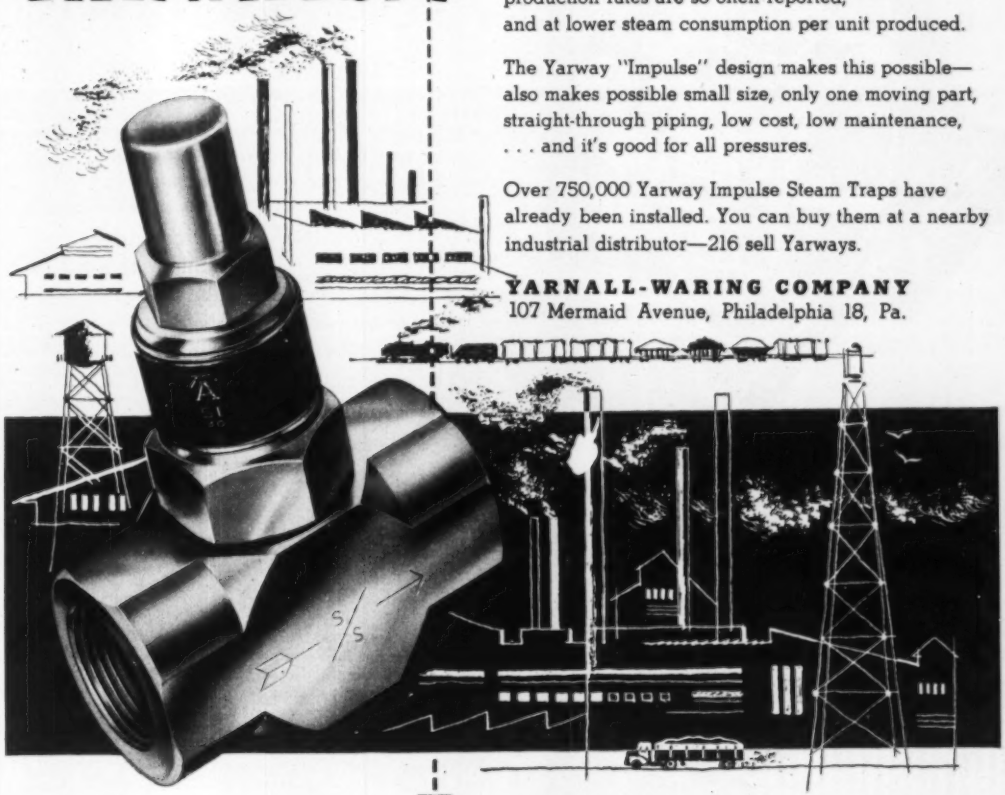
Yarway Impulse Steam Traps do all this, *sending the most premium B.T.U.'s at top temperature into your process or product.*

That's why equipment drained with Yarways gets "hotter, sooner" . . . why better quality and higher production rates are so often reported, and at lower steam consumption per unit produced.

The Yarway "Impulse" design makes this possible—also makes possible small size, only one moving part, straight-through piping, low cost, low maintenance, . . . and it's good for all pressures.

Over 750,000 Yarway Impulse Steam Traps have already been installed. You can buy them at a nearby industrial distributor—216 sell Yarways.

YARNALL-WARING COMPANY
107 Mermaid Avenue, Philadelphia 18, Pa.



FREE OFFER
Don't take our word for it. Test Yarway's production advantages in your own plant, without cost or obligation. Drop us a card. A trial trap will be delivered promptly.

YARWAY the steam trap designed with production in mind

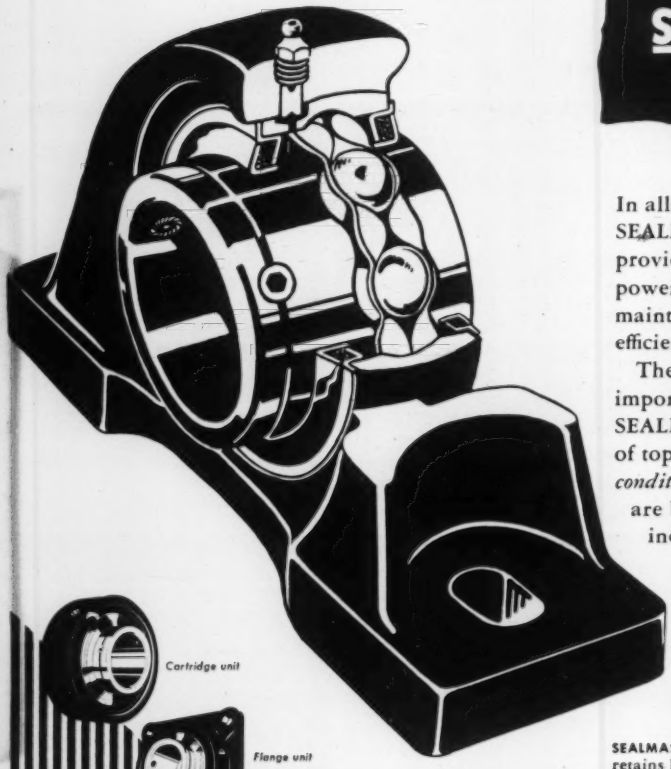
Wherever used...

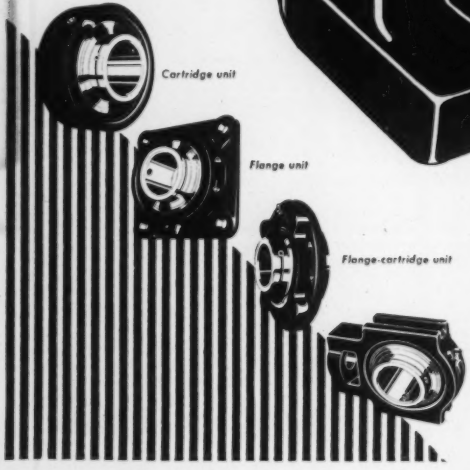
THEY ADD

BUILT-IN PERFORMANCE

SEALMASTER

BALL BEARING UNITS





In all types of machines, SEALMASTER Ball Bearing Units provide smoother operation, reduced power consumption, minimum maintenance and general all-round efficiency.

The exclusive combination of important features found only in SEALMASTERS is the best assurance of top performance *under all conditions*—superior qualities that are built right into each individual bearing.

Write for your copy of Catalog 845 which gives dimensions, load ratings and other data on the complete line of SealMaster Bearing units. If you have a special bearing problem ask one of our bearing specialists to assist you.

SEALMASTERS' patented centrifugal seal retains lubricant and excludes dirt. Self-aligning bearing assembly permits alignment without seal distortion. Factory-lubricated, ALL SEALMASTERS are shipped *ready for use.* Patented locking pin and dimple prevents rotation of outer race in housing and positions unit for relubrication.

SEALMASTER BEARINGS

47 RIDGEWAY AVENUE, AURORA, ILLINOIS

A DIVISION OF STEPHENS-ADAMSON MFG. COMPANY

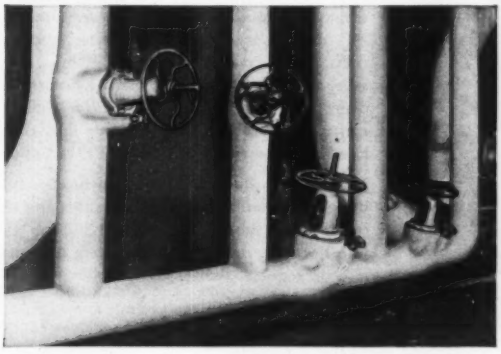
FACTORY REPRESENTATIVES AND DEALERS IN ALL PRINCIPAL CITIES

a better gate valve for 600-pound services ...CRANE pressure-seal bonnet design

Better—because these Crane valves completely eliminate bonnet joint maintenance. And because they assure power plants—industrial and utility—ideal flow conditions, with many added cost-reducing advantages.

For instance, they save on erection and suspension costs, because, size for size, Crane Pressure-Seal Bonnet Gates are much lighter in weight and more compact than flanged bonnet steel valves. Insulating Pressure-Seal valves takes less time and materials because of streamline contouring.

For complete information about Crane 600-Pound Pressure-Seal Bonnet Gates—also companion lines of 900 and 1500-Pound Gates, Globes, Angles, and Stop-Checks—send for Circular Ad-1819, or ask your Crane Representative for a copy.



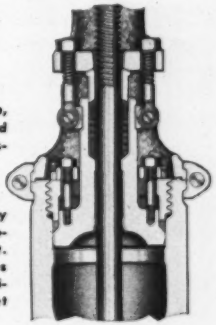
Boiler feedwater header in central station. No danger of bonnet-joint leakage; valves are Crane Pressure-Seal Bonnet Gates.

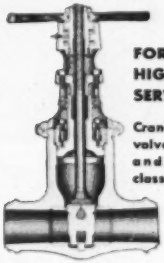
Patented and Patents Pending

600-Pound Butt Welding Gate for temperatures up to 1000° F. max.

NO BONNET-JOINT LEAKAGE OR MAINTENANCE

Bonnet joint is inside the valve, sealed with a wedge-shaped seal ring. Internal fluid pressure, acting upon the entire underside of bonnet, forces bonnet against seal ring and wedges it between the body and bonnet to form a pressure-tight metal-to-metal joint. Since pressure tightness does not depend on bolting, no periodic restressing of bonnet joint is needed.





FOR HIGH-PRESSURE HIGH-TEMPERATURE SERVICES

Crane Pressure-Seal Bonnet Gate valves are also available in 900 and 1500-Pound pressure classes.

CRANE CO.

General Offices:
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

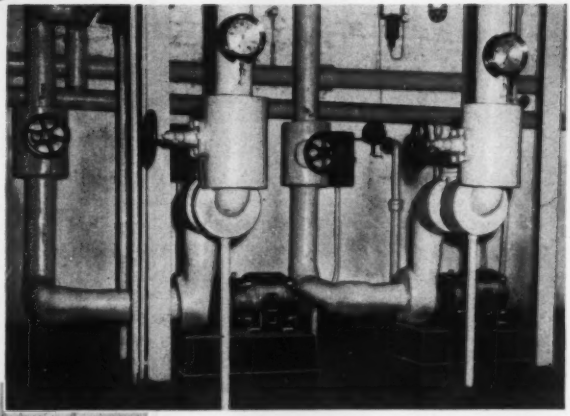
VALVES • FITTINGS • PIPE • PLUMBING • HEATING

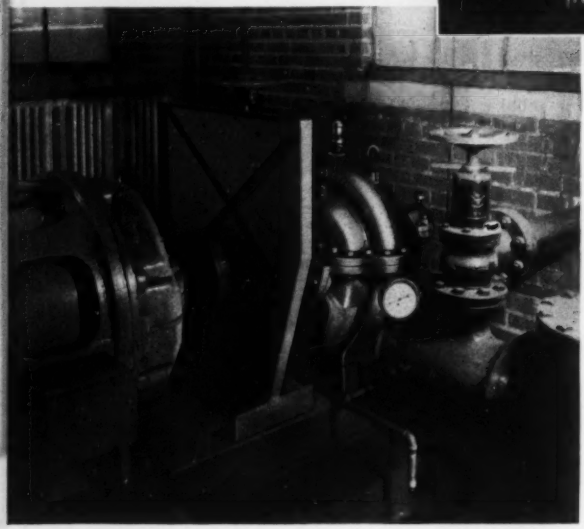
2 TYPES OF "Buffalo" PUMPS

FOR EFFICIENCY ON YOUR CLEAR WATER JOBS!

CLOSE-COUPLED! SPACE-SAVING!

. . . and ruggedly built to stand severe service, as in this installation of two "Buffalo" Close-Coupled Pumps handling chilled water. Close-Coupled construction, with impeller overhung on motor shaft, means permanent alignment. These compact single suction pumps with flanged openings can be installed vertically or horizontally. BULLETIN 975-B, completely describing "Buffalo" Close-Coupled Pumps, will be mailed to you on request.





WHEN YOU WANT HIGH VOLUME IT'S "S/L"

. . . "Buffalo" Double-Suction Type "SL" Pumps are of the finest obtainable construction, hydraulically balanced, and built in sizes to handle up to 10,000 gpm at heads up to 350 feet. Here are the pumps specified for the large air conditioning jobs, and for all continuous-service clear water applications. You can install "SL" Pumps with every expectation of peak efficiency, long, dependable service and inexpensive maintenance. It will pay you to look into these fine pumps — write for BULLETIN 955-N.

NOTE: "Buffalo" also manufactures a full line of fans, unit heaters, air washers and air conditioning units for any air handling application you may have. Complete information on request.

"Buffalo" PUMPS

BUFFALO PUMPS INC.

171 MORTIMER ST. BUFFALO, NEW YORK

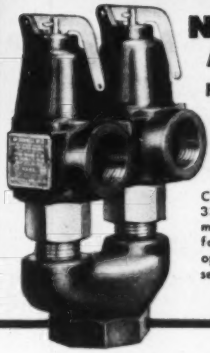
Canada Pumps, Ltd., Kitchener, Ont.
Branch Offices in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

Now small and large

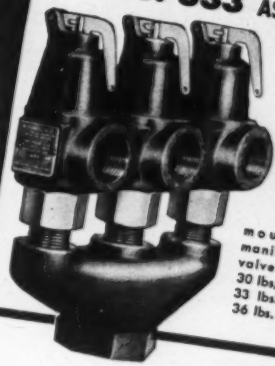
No. 33
SAFETY RELIEF VALVE
FOR HOT WATER BOILERS UP TO 242,900 BTU/HR OUTPUT

Opening pressure, 30 lbs. Discharge capacity covers most hot-water heating boilers.



No. 233 ASSEMBLY
FOR BOILERS UP TO 496,700 BTU/HR OUTPUT

Consists of two No. 33 Series valves mounted on manifold. First valve opens at 30 lbs.; second at 33 lbs.



No. 333 ASSEMBLY
FOR BOILERS UP TO 769,400 BTU/HR OUTPUT

Consists of three 33 Series valves mounted on manifold. First valve opens at 30 lbs; second at 33 lbs.; third at 36 lbs.

Authority speaks — Here is a straight forward statement from a recent bulletin issued by the highest authority on pressure vessel safety:

> "If a user wishes to protect a hot-water supply boiler or a hot-water heating boiler, the rules outlined in the 1949 A.S.M.E. Low-Pressure Heating Boiler Code and the 1950 Addenda thereto should be followed. In brief those rules require that all hot-water heating boilers and all hot-water supply boilers be equipped with *rated* relief valves. The relieving capacity of these rated relief valves should be equal to the heat output of the hot-water heating boiler or the hot-water supply boiler."

Every good heating man wants to conform to this regulation. As you no doubt know it was put into effect because the only sure way to protect a hot-water heating boiler from the disastrous overpressures produced by "runaway" firing is to provide a valve having a heat discharge capacity equal to the gross heat output of the boiler on which it is installed.

To conform with this ruling, it is only necessary to determine the heat output of the hot-water heating boiler; then equip it with a valve having equal or greater heat discharge capacity. This is easy when you equip it with a McDonnell 33 Series Safety Relief Valve. Each McDonnell Valve has its capacity in Btu. per hr. plainly shown on its name plate. The A.S.M.E. symbol is your proof that it has complied with all testing procedures outlined in the code.

As shown above, a single No. 33 Valve has a discharge capacity sufficient for about 70% of all boilers. But there still remains the larger boilers that need protection equally, and for these we have developed the No. 233, two-valve and No. 333, three-valve assemblies illustrated above. Thus you can now have McDonnell protection for boilers of larger size.

The No. 233 and 333 assemblies consist of two or three Series 33 valves mounted on manifolds as shown. They are packaged completely assembled on the manifolds, ready for easy installation. Their opening pressures are set so that they open successively—first valve at 30 psi, second valve at 33 psi and third (if 333 assembly is used) at 36 psi. By this method it is possible to retain the basic advantage of 33 Series valves —low discharge rate with small orifice to take care of normal thermal expansion and high discharge rate to take care of a high temperature condition of overfiring. This is explained opposite. In contrast, if a single high capacity valve is utilized, the opening of a large orifice on thermal expansion will result in a needless large discharge rate that can easily be avoided by using a small easier-to-close orifice of the 33 design.

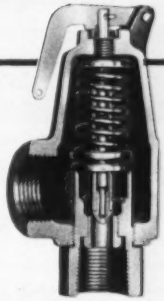
Complete details covering application and installation of No. 233 and 333 Assemblies are covered in a new bulletin. Basic facts are all given in the new McDonnell Condensed Catalog and Price List. Write.

McDONNELL & MILLER, Inc., 3500 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

Your Jobber Stocks Them

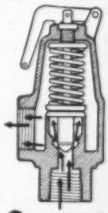
McDONNELL



McDonnell 33 Series Safety Relief Valves are built to comply with the A.S.M.E. Boiler Code and have been tested and rated by the National Board of Boiler and Pressure Vessel Inspectors.

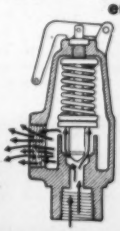
They have ideal operating characteristics:

1. Low discharge rate for normal operation



When boiler pressure reaches set opening pressure valve cone lifts just far enough to discharge water at low rate necessary to take care of thermal expansion. This advantage is retained whether one, two, or three valves are used.

2. High discharge rate for emergency operation

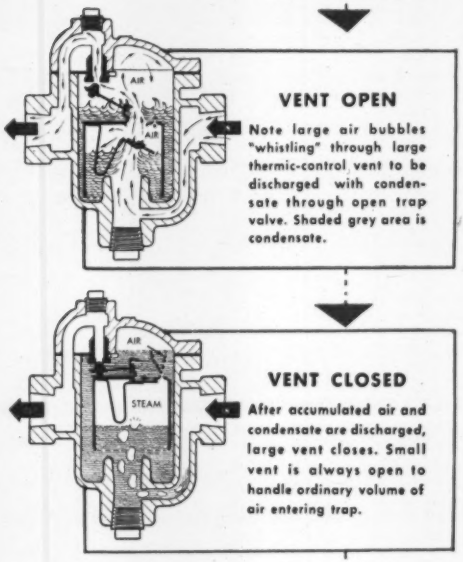


If for any reason steaming condition occurs, increased velocity acts on ingenious "Hydra-lift" disc, lifting valve wide open with snap action and discharging full rated capacity. Any emergency condition causes full opening whether one, two, or three valves are used.

ARMSTRONG "BLAST" TRAPS SPEED UP HEATING

of Single Pipe Coils, On-and-Off Multiple Coils, Unit Heaters, etc.

AIR WHISTLES RIGHT THROUGH


AIR
AIR
VENT OPEN
Note large air bubbles "whistling" through large thermic-control vent to be discharged with condensate through open trap valve. Shaded grey area is condensate.
AIR
STEAM
VENT CLOSED
After accumulated air and condensate are discharged, large vent closes. Small vent is always open to handle ordinary volume of air entering trap.

IN equipment where large amounts of air accumulate when the steam is turned off, and where the air can be pushed out ahead of the steam, Armstrong "Blast" Traps provide remarkably fast heat-up. A corrosion resistant invar and stainless bi-metal strip holds open a very large vent which lets air whistle right through the trap when equipment or lines are cold. As soon as steam reaches the trap, the bi-metal closes the big vent.

Armstrong Blast Traps combine the benefits of quick heat-up with the dependable service of mechanical traps. There is no bellows to leak or collapse due to high pressure. In fact, the traps are hydraulically tested at 500 lbs. pressure before they leave the factory.

Call your nearby Armstrong Representative for details and prices.

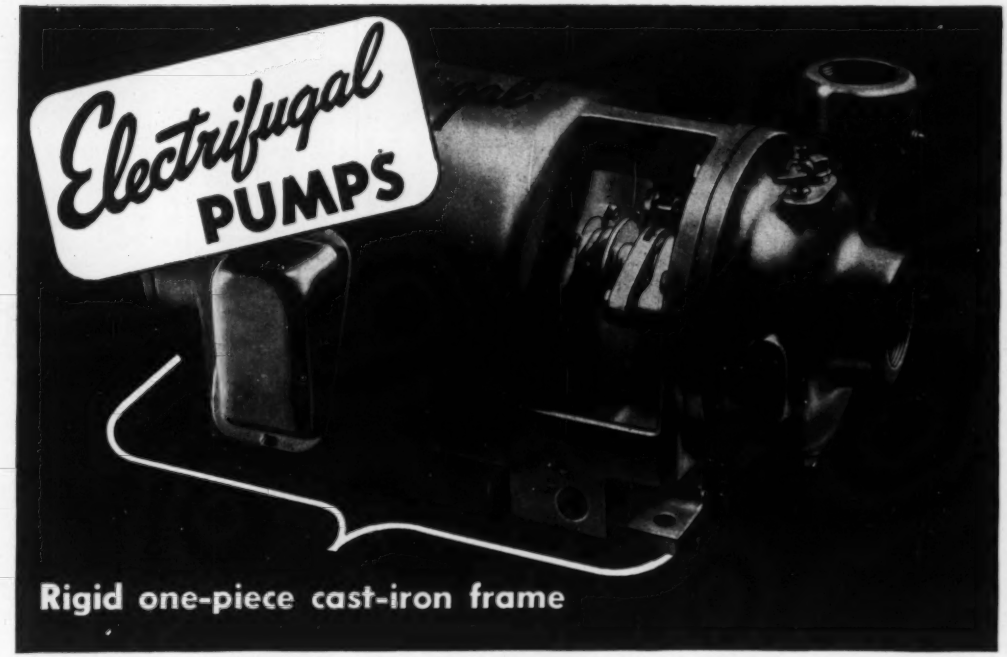
ARMSTRONG MACHINE WORKS

874 Maple Street • Three Rivers, Michigan

THE ARMSTRONG STEAM TRAP BOOK tells all about Armstrong Blast and Standard Traps—where to use them and how to select and install them. You are welcome to a copy. Just write for it.

SEE OUR CATALOG IN SWEET'S

ARMSTRONG STEAM TRAPS



This is the difference between close-coupled pumps

THIS EXCLUSIVE FRAME DESIGN combines maximum space for packing maintenance with exceptional rigidity in a way that no pump assembled to a standard motor can do. Solid cast iron frame with no joints from motor end housing to pump casing assures permanent alignment.

Bearings are lubricated at the factory and should require no attention for years. The stuffing box carries plenty of packing and all parts are generously proportioned for heavy duty service. Wearing rings and shaft sleeves protect casing and shaft from wear and are easily replaced at low cost when worn. As a result, you will find exceptional freedom from high maintenance costs.

Unit Responsibility Means Dependability

Motor and pump are designed for each other and made in the same plant. You have one responsible source for both... one guarantee of satisfaction. Every Allis-Chalmers pump representative is a competent application engineer who will help you select exactly the right pump for your needs. And 94 Allis-Chalmers Certified Service Shops provide nation-wide factory approved service.

Talk over your pump selection problems with your Allis-Chalmers Authorized Dealer or Sales Representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin for Bulletin 52B6140.

A-3337

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

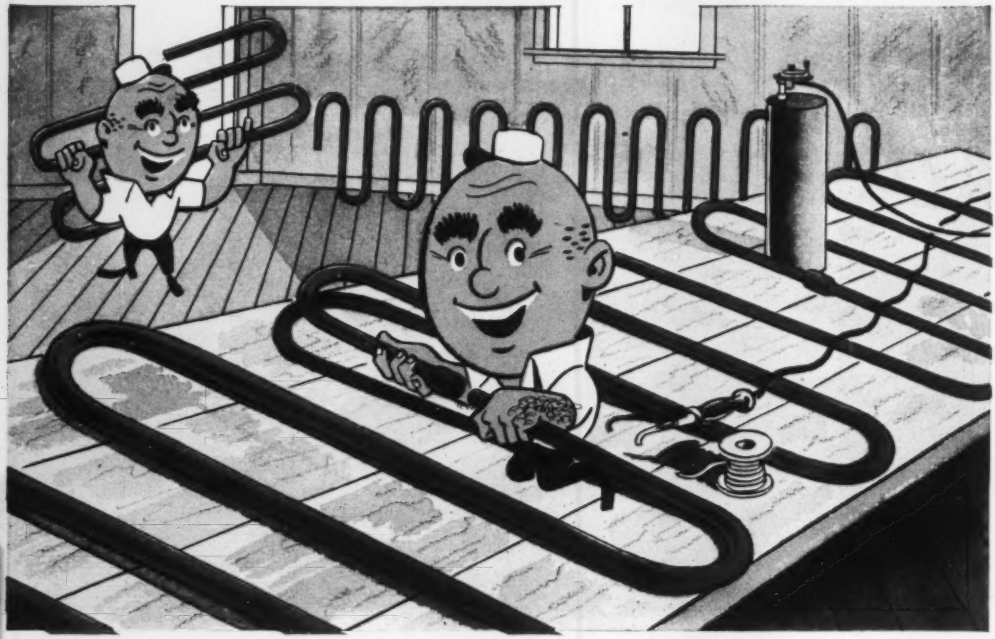
MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

Electrifugal, Texrope and Vari-Pitch are Allis-Chalmers trademarks.

ALLIS-CHALMERS



Form radiant heating grids faster, too . . . with Bundyweld

NOTE that Bundyweld expanded end, above. It spells *even easier* radiant heating installation!

For twenty-foot lengths of Bundyweld Tubing can be sent to your building site with one end expanded (*if specified*). Then, one man quickly forms grid on simple fixture . . . slips unexpanded end into expanded end of the next grid, and silver brazes (or soft solders) grids into strong, permanent, leakproof union.

Two men can easily position the rigid, lightweight Bundyweld sections on ceilings or in floors. No hitches, delays. In jig time, your Bundyweld radiant heating system is all set, to the tune of a major savings in time and costs.

Bundyweld is double-walled from a single strip, copper-bonded through 360° of wall contact. It's stronger-walled, thinner-walled; bends more readily without collapsing structurally. Uniformity, even flow, maximum heat conductivity are yours!

Write today for the complete Bundyweld radiant heating story. ***Bundy Tubing Company, Detroit 14, Michigan.***

Bundyweld® Tubing

DOUBLE-WALLED FROM A SINGLE STRIP

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of basic metal, coated with a bonding metal. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness, and

passed through a furnace. Bonding metal fuses with basic metal, presto—

Bundyweld . . . double-walled and brazed through 360° of wall contact.

NOTE the exclusive patented Bundyweld beveled edge, which affords a smoother joint, absence of bead and less chance for any leakage.

Include DOREX AIR RECOVERY in your air conditioning or heating plans

Fresh air isn't "for free" in an air conditioning system. It costs plenty to heat or cool. So the secret of economy is: reduce the amount of fresh air that has to be brought in from the outside to maintain air quality inside. Dorex Air Recovery does just that—gives you a real bargain by maintaining fresh air quality with *as little as one-third the normal intake of outside air!*

Dorex Air Recovery "manufactures" *fresh* air from *used* air by removing all odorous and gaseous impurities. The heart of the matter is the remarkable Dorex C Cell with its beds of activated carbon—the most effective air purifier known.

Since with Dorex Air Recovery you have less new air to heat or cool, you need less heating and cooling capacity. This saves both critical material and money—some $400 for every $100 invested in Dorex. And every $1 spent for Dorex maintenance should return a $4 saving in operating costs.

The effectiveness and economy of Dorex Air Recovery have been proved by more than 7,000 installations in the past 20 years. To find out more about Dorex, mail the coupon today.

DOREX

Air Recovery

W. B. CONNOR ENGINEERING CORP.

Danbury, Connecticut

Air Diffusion • Air Purification • Air Recovery

In Canada: Douglas Engineering Co., Ltd.,
190 Murray Street, Montreal 3, P. Q.

TRADE MARK "DOREX" REG. U. S. PAT. OFF.

W. B. CONNOR ENGINEERING CORP.
Dept. A-71, Danbury, Connecticut

Please send me, without obligation, full information on Dorex Air Recovery

Name .....

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Company .....

Street .....

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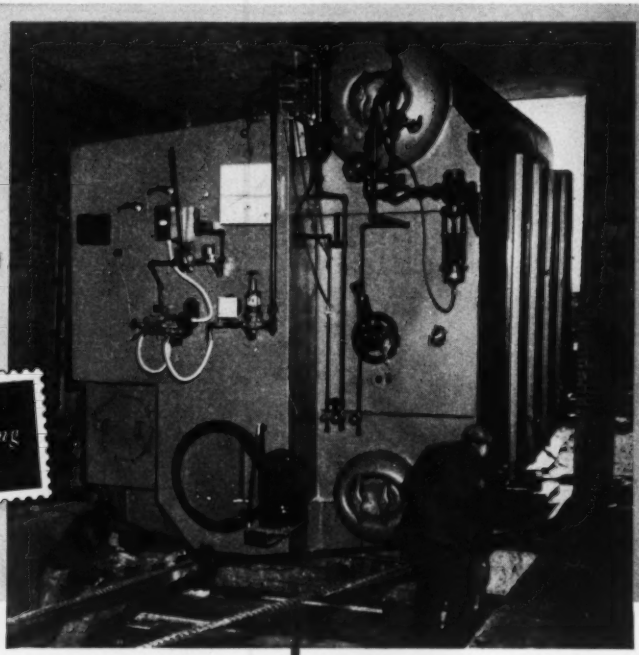
LOOK what's here!

NOW... the popular B&W Integral-Furnace Boiler design available in cost-saving shop-assembled unit

A Product of B&W Engineering for Economy



Now, for the first time . . . all the inherent advantages of "packaged" boilers, *plus* the traditional economies of B&W's Integral-Furnace construction, are combined in a new factory-assembled water-tube unit. It's the B&W Integral-Furnace Boiler, Type FM—delivered fully equipped for immediate operation.

A modern development of the original B&W Integral-Furnace Boiler, this new unit embodies the experience gained through engineering and build-over 100 million pounds per hour of installed steam capacity to the same basic design.

Small and medium size plants, institutional and commercial establishments will find in this unit all the answers to low-cost heating and process steam-generating requirements from 2,800 to 25,000 lb. per hr. at pressures to 250 psi. Large plants, too—where space and load characteristics warrant—may profitably consider several packaged boilers as against a "tailor-made" installation.

Helping Industry Cut Steam Costs Since 1876

Cost-saving features of the new B&W Integral-Furnace Boiler,

TYPE FM

Saves Erection Time and Cost
Meets Wide Range of Service
Handles Quick Load Changes
Fast Steaming
Low Maintenance
Easy Accessibility
Suitable for Outdoor Service
Burns Oil and/or Gas
Saves Fuel
Saves Space
Safe, Automatic Operation

Send for bulletin G-72, detailing the many advantages of this new B&W creation in low-cost steam generation. The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

G-490

THE EDITOR'S PAGES

• INCLUDED IN THE many, many requests for information on almost every phase of heating, piping and air conditioning which come to us each month—and which we're more than glad to receive and to answer to the best of our ability, as they often are most helpful in our editorial planning—are quite a few for extra copies of articles which have been published in back issues of HPAC. It is a tribute to the excellence of the memories of HPAC's readers (or to the efficiency of library reference services) that a number of these requests are for articles that have been published many years ago . . . . When tear-sheets or reprints of an article are still available, we're happy to send a copy to an HPAC subscriber with our compliments. Frequently, there are no longer reprints or tear-sheets, but a complete copy of the issue containing the particular article can be furnished at nominal cost. And if our supply of a certain back issue is exhausted, photostats can be prepared at reasonable cost from the bound volumes in our office or by one of the libraries offering such a service . . . . So if you need an article which ran in HPAC, let us know as completely as you can its title, author, and month and year of publication and we'll be glad to get it to you as economically as is possible.

CONSTRUCTION CONTRACTS GAIN MARKEDLY

CONSTRUCTION CONTRACTS awarded in the 37 states east of the Rockies during May showed marked gains over April and were substantially ahead of May 1950, according to an announcement last month by F. W. Dodge Corp. The May figure for the 37 states was $2,572,961,000 — 87 percent above the previous month and 91 percent more than May a year ago.

The first five months of 1951 were also ahead of the corresponding 1950 period by 34 percent with a figure of $7,399,177,000.

Non-residential contracts at $1,633,908,000 in May were 215 percent more than April and 300 percent greater than May a year ago. Residential awards of $661,094,000 were 12 percent above April but 2 percent below May 1950. Public and private works and utilities at $277,959,000 were 4 percent higher than April and 5 percent greater than May last year.

Five-month totals for 1951 showed the following gains over the comparable 1950 period: Non-residential, $3,513,365,000, up 89 percent; residential, $2,778,575,000, up 6 percent; public and private works and utilities, $1,107,237,000, up 8 percent.

"QUOTE"

"Air conditioning has made the 'block' type building possible, just as steel and the elevator made the skyscraper possible. I doubt if we ever build a 'wing' type building again. Floor space simply costs too much in a 'wing' type plan."—JESS LARSON, Administrator of General Services, General Services Administration, at a conference on the relation of environment to work.

STEEL BOILER OUTPUT NOT MEETING DEMAND

BECAUSE OF material shortages, production of steel boilers is insufficient to meet the current demand. This fact dominated the recent annual meeting of the Steel Boiler Institute at French Lick, Ind.

The demand for steel boilers currently is stronger than it was during the corresponding period in 1950, it was pointed out at the meeting. Yet production and shipments of steel boilers are less than they were at this time in 1950.

R. A. Locke said that in his opinion the government should not approve construction without also at the same time providing the heating industry with the materials necessary to heat the buildings they have permitted to be erected.

It was decided at the meeting that the SBI will publish a brochure on the steel boiler industry which will show size of the plants, number of men employed, and their manufacturing potential in peace as well as in war. It will be distributed to key government personnel and others who should be acquainted with the characteristics of the industry.

Some months ago the SBI inaugurated an industry-wide program for the treatment of boiler water to retard corrosion.

Particularly timely today, because of the importance of conserving critical materials, the institute's program will be extended to existing boilers now in service as well as new boilers.

All purchasers of new boilers will be given a package of boiler water treatment compound and its use will be explained to the person responsible for the care and maintenance of the boiler. The compound retards corrosion caused by oxygen and acidity of the boiler water.

CAST IRON BOILER, RADIATOR SHIPMENTS UP

WITH SHIPMENTS OF cast iron boilers in the first quarter of 1951 93.4 percent ahead of shipments during the first quarter of 1950, members of The Institute of Boiler and Radiator Manufacturers, at their spring meeting at the Skytop Club, Skytop, Pa., expressed optimism over business conditions.

Shipments of cast iron radiators during the first quarter of 1951 were 62.9 percent above the corresponding period of 1950, it was reported by R. E. Ferry, IBR's general manager.

With 90 members and associate members present, the meeting attracted the largest attendance in the history of the institute.

A testing and rating code for finned tube radiators was adopted at the meeting.

It was reported that a considerable number of manufacturers of both ferrous and nonferrous baseboards have had IBR ratings approved.

That the School of Modern Heating, now in its second year, is the most successful educational program ever undertaken by the institute was reported by Mr. Ferry. A total of 2647 students have attended the 46 schools held between April 11, 1950,

and April 24, 1951, Mr. Ferry reported. The average attendance so far in 1951 is 71 as compared with 51 in 1950.

A report on the IBR research program at the University of Illinois was made by Warren Harris, research associate professor, department of mechanical engineering. He said an investigation made this winter was a study of the performance of baseboard radiation mounted at the ceiling level. "This method of mounting baseboards presents one possible solution to the heating of such rooms as kitchens, where cabinets take up nearly all of the wall space at the floor," he said. "The limited data obtained would seem to indicate that radiant type baseboard may be mounted near the ceiling in isolated rooms where there is not sufficient available space along the baseboard. Convector type baseboard located at the ceiling produces an excessively warm ceiling," according to Professor Harris.

"In mounting baseboard at the ceiling it should be located along the outside walls and some allowance must be made for the lower output obtained at the ceiling location. In the tests, the installed capacity of the radiation used at the ceiling was 20 percent greater than that used at the floor. If anything, this was slightly more than required but the tests were not of such a nature as to enable us to determine the exact reduction in output resulting from locating the units at the ceiling," he stated.

Professor Harris told IBR members that the major study made during the 1950-51 heating season had as its objective the determination of how much the piping and pick-up factors for small automatically fired hot water boilers could be reduced.

"With the hot water system used for these tests, a piping and pick-up factor of 1.20 is the lowest that could possibly be used and still be able to operate on night set-back at design conditions," Professor Harris said. "However, since a reasonable margin of safety should be provided, the use of a piping and pick-up factor of less than 1.25 could hardly be recommended.

"The investigations at the University of Illinois confirm the basis on which revised IBR piping and pick-up factors for small automatically fired hot water boilers were recently determined; namely, a maximum piping and pick-up factor of 1.33," he concluded.

SUNSHINE'S NOW FACTOR IN AIR CONDITIONING

NEWLY DEVELOPED sun lamps irradiating all office areas, germ-killing sterilizing lamps in the air conditioning system (and on the walls of the office cafeteria and washrooms), bright and varied colors to provide cheerful surroundings, and—of course—complete air conditioning of the entire space feature the new northwestern district headquarters of the Westinghouse Electric Corp. in the Merchandise Mart, Chicago.

In the general offices, the sun lamps produce the equivalent of 15 minutes in the summer sun over an 8 hr day. In private offices, reflectors aim the radiation in stronger doses and the lamps can be turned on and off by the occupant.

Air conditioning for the space is provided from the Mart's extensive central installation.

AIR CONDITIONING of these new offices includes "sunshine control." A row of the sun lamps can be seen here between the lines of regular fluorescent lights

REPORTS RECORD SALES, PROFITS

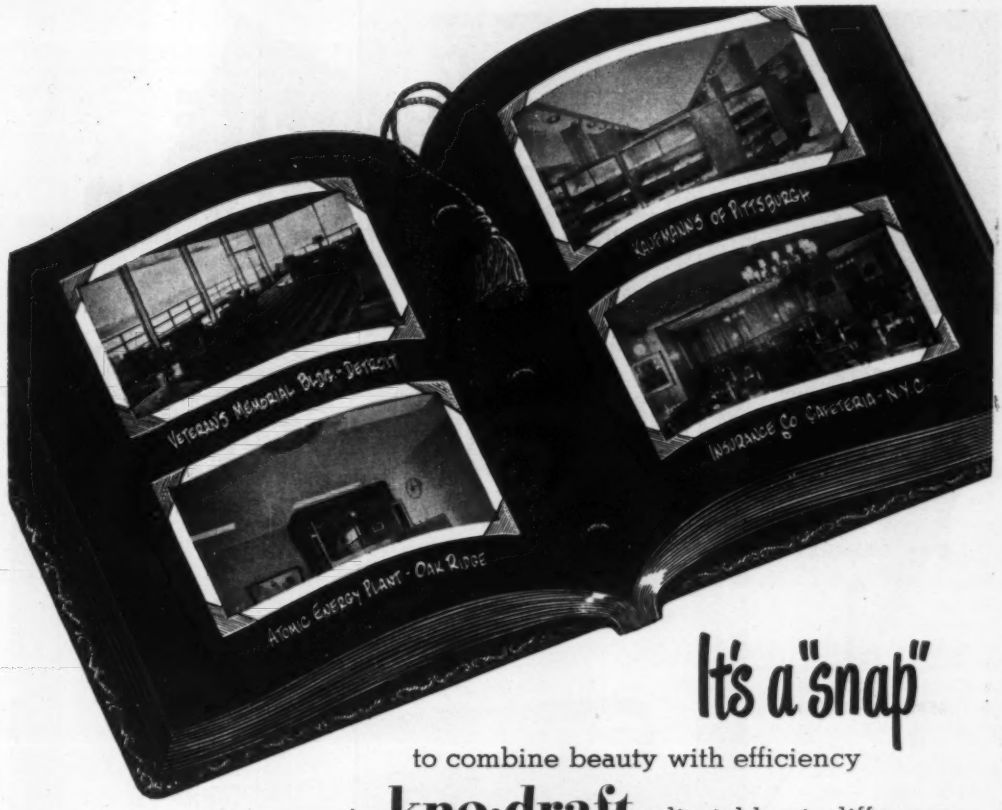
DURING THE 12 months ended April 30, 1951, new high records with respect to completed sales and net profits were established by Carrier Corp., manufacturer of air conditioning and refrigeration equipment.

Net profit was $4,737,360, compared with $1,099,046 during the 12 months ended April 30, 1950. Completed sales totaled $76,586,570, the comparable figure for the preceding year being $44,358,536. New orders were booked in the amount of $87,888,077 as compared with $49,603,083 in the previous 12 months. Backlog of unfilled orders as of April 30, 1951, totaled $44,434,022 as compared with $26,180,781 a year earlier. The current backlog figure, as well as that having to do with new orders booked, are exclusive of some $50 million of special defense business.

Commenting on earnings and volume, Cloud Wampler, president, pointed out that profits for the six months ended October 31, 1950, were larger than normal and that completed sales for the six months ended April 30, 1951, reflected a stepped-up production and shipment program. Accordingly, Mr. Wampler said, the report for the 12 months ended April 30, 1951, combines two periods in which unusually favorable conditions prevailed.

"GREATEST PRODUCTION DRIVE IN HISTORY"

EVERY AMERICAN must prepare for " a first-team role" in the greatest production drive in world history if the United States is to retain its peacetime health while building its global defenses, according to Chester H. Lang, of General Electric Co.



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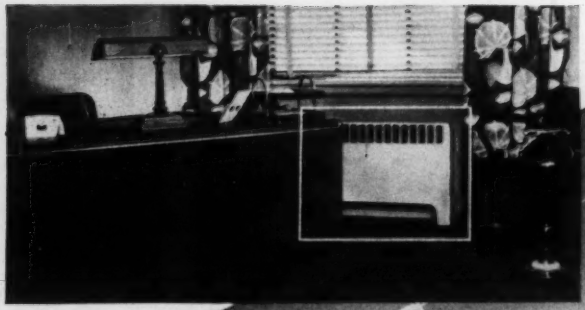

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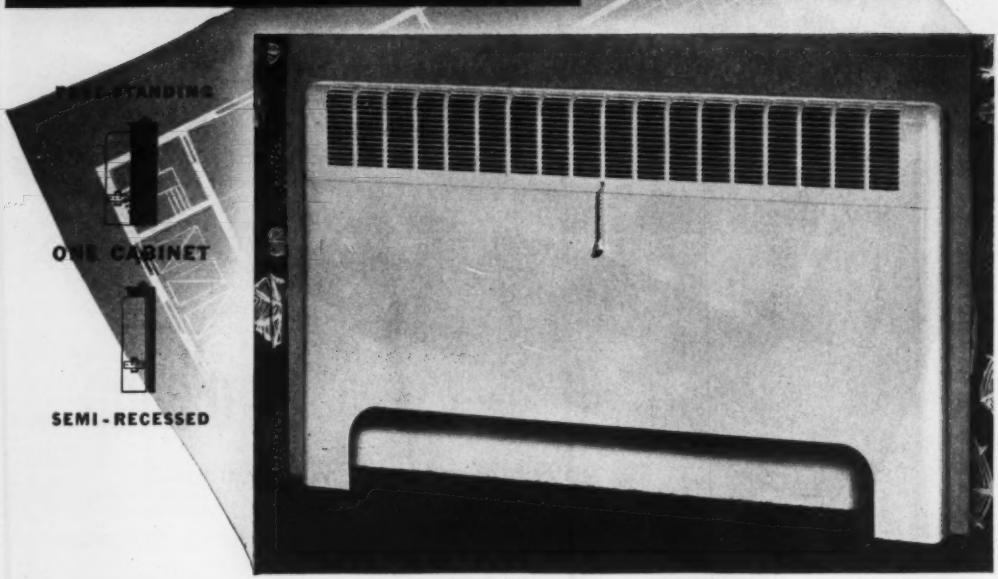

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• How about expressing your views on one of the articles in this month's issue of HPAC, for publication in these pages? Your comment on a controversial point, or additional information based on your experience, would be of interest and help to others. Or perhaps you'd like to say a little on some other matter of importance to plant engineers, building engineers, heating, piping and air conditioning engineers or contractors? We follow here each month the practice at engineering society meetings of providing an "open for discussion" period. You are invited to participate. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

WHAT IS A DRAFT?

What is a draft? asks "J.H.C." in the May Heating, Piping & Air Conditioning, and suggests that some "discussion" on the matter should be of interest. Having studied this question rather intensively in connection with the development of a system of classroom ventilation, I feel that I may be able to provide at least the broad basis of an answer. Unfortunately, the subject is complicated, so I cannot be brief — but I will try to be as brief as possible.

A draft is an air movement within an enclosure of sufficient cooling power to cause local chilling of the more exposed portions of the body. I limit this definition to air movement within enclosures in conformity with popular usage whereby outdoor air movement is described as a breeze, wind, etc., rather than as a draft. The word "chilling" may seem a bit drastic but is justified in my opinion by the fact that when an air conditioning engineer speaks of a draft, he means what laymen sometimes call a "cold draft"—that is, an air movement that is not merely perceptible but has an appreciable cooling effect. Local chilling is specified because we rarely feel a draft with our entire body; we feel drafts on our faces, our bare arms, our ankles, the backs of our necks, and so on.

The moot point, of course, is what constitutes "air movement of sufficient cooling power" to be identified as a draft. As "J.H.C." pointed out, this depends both on the temperature and velocity of the air stream. It also depends on a number of other factors, including the surrounding thermal conditions. A draft is above all a *difference* between a particular aspect of the thermal environment and its general aspect. An air movement capable of producing local chilling under one set of conditions may, under other conditions, be barely perceptible. A person who is overheated to the point of perspiration may nevertheless complain of a draft; in fact, he is more likely to be conscious of air movement — especially in dry air — than someone who is not overheated. In the same way, a person who has a cold is more sensitive to drafts than a healthy individual, owing to the flushed condition of his skin.

Thus the question of what constitutes "air movement of sufficient cooling power to produce local chilling" is dependent on a great many variables:

1) Velocity of the air stream.
2) Temperature of the air stream.
3) Relative humidity of the air stream.
4) Surrounding thermal conditions.
5) Duration of exposure.
6) Degree of exposure (clothing).
7) Physical and physiological state of the individual.

We can, however, eliminate most of these by assuming a set of standard conditions which can be regarded as the "normal" conditions under which the type of draft under consideration is critical. Thus, if we assume a healthy person engaged in a sedentary occupation and wearing clothing suitable to the occupation, under otherwise comfortable winter heating conditions, most of the variables are eliminated, and we come back to the matter of the velocity and temperature of the air stream (under winter heating conditions, relative humidity is of little, if any, significance). In the case of summer cooling, the problem may be complicated by the after-effects of exposure to overly-hot conditions, and in the case of winter heating, it is influenced by the general turbulence, or lack of turbulence, of the surrounding air, but in general it is a matter of the velocity and temperature of the air stream, and the contrast with surrounding conditions.

Winslow and Herrington [see Temperature and Human Life, Princeton University Press, 1949] assert that the convection loss of the nude body, at a given difference between skin temperature and air temperature, varies with the square root of air velocity at low air movements. Thus, the bodily convection loss for a nude subject is approximately doubled by an increase in air velocity from about 15 fpm to 65 fpm, and tripled by an increase from 15 to 150 fpm. If we make the rough assumption that the convective heat loss, plus that portion of the evaporative loss which is also effected by air movement, amounts to about one-half of the body's total heat losses, this means that moderate air movement (about 65 fpm) increases the total heat loss of the nude body about 50 percent, and a high rate of indoor air movement (about 150 fpm) increases total heat loss almost 100 percent, in the case of a nude subject.

Since merely walking at the rate of 2 mph induces a greater rate of air movement than the higher of these figures, it is obvious that clothing has a very considerable moderating influence on the effect of drafts. However, it is true that under the exceptionally still-air condition associated with panel heating, one may be conscious of the "draft" resulting from merely moving from place to place, or even, when seated, the air movement produced by a person passing behind one's chair. Both of these effects are, of course, very transitory,

but they are nevertheless somewhat annoying, if only because they are so unexpected.

By making various assumptions regarding skin temperature, comfortable operative temperature, and so on, which will not be detailed here, it is possible to arrive at an approximation of the relative cooling effect on bare skin of air at various rates of movement and various temperatures:

Air temp.	Still air, 0-15 fpm	Moderate air movement, about 65 fpm	High air movement, about 150 fpm
74°	1	1½	2
65°	1½	2¼	3
48°	2½	3¾	5

Since there are virtually no physiological data available on irregular heat stress, it is impossible to check these figures against experimental findings. In the absence of such information, however, they serve to indicate, in an approximate way, what the relationship between temperature and velocity, in inducing the sensation of a draft, may be. It may be assumed, for example, that under normal winter heating conditions air movement up to 65 fpm will not be objectionable, provided the air stream is at room temperature, but that air movement at a rate much higher than this will prove objectionable, especially to lightly-clothed individuals. If this is true, and the figures given are any where near correct, it is also true that an air stream as cold as 65 deg will also prove objectionable, even though moving at only 65 fpm. This checks fairly well with everyday experience, and is indicative of the delicate interrelationship between temperature and velocity in determining "what is a draft."

What is needed for the study of this question is a "draftmeter" consisting of a hot wire anemometer calibrated to show the relative cooling power of still air and air in motion, with the element heated to about 91½ deg — or the skin temperature associated with the sensation of comfort. Such an instrument would be somewhat more sensitive to drafts than an exposed portion of the body, since it would not have the benefit of a blood stream from other parts of the body to average the cooling effect, nor would it be equipped with capillaries to contract and provide a degree of insulation for the heating element. Systematic correlation of the readings with observed sensations would soon supply an index against which drafts could be measured. It might be found, for example, that an air stream with a cooling power of 2 (twice that of still air at the comfort temperature) would be sensed as a draft by an office worker in a light dress in a slightly overheated office, whereas an air stream cooling power of 2½ would be required to register as a draft in the vicinity of the feet and ankles of a man wearing wool socks. For summer air conditioning work, the results would probably have to be interpreted in the light of the dry bulb temperature.

While there is nothing particularly conclusive about any of the statements made herein, I hope I have succeeded in establishing some background facts. For example:

1) Anyone who asserts that a draft is a matter of an air velocity of so many feet per minute, or air at a certain temperature, is talking nonsense unless he relates these two factors to one another.

2) What a draft is under one set of conditions will not be regarded as such under another set of conditions; basically, a draft is a matter of a difference between the cooling power of an air stream and the surrounding conditions to which the body has become adapted.

3) It takes only a small drop in the air temperature, combined with a small increase in the rate of air movement, to be sensed as a draft.

4) Prolonged exposure of bare or lightly clad skin greatly increases our sensitivity to drafts; most complaints of drafty conditions are the result of such exposure.

5) Under summer conditions, our sensitivity to drafts may be greatly increased by perspiration, especially in very dry air.

6) The nude body is extraordinarily sensitive to air movement — a fact which should be taken into account in the conditioning of shower rooms and similar spaces.

7) The present state of the art, and of scientific knowledge, is not such as to provide reliable information on the exact point at which desirable air movement becomes undesirable, but experience has already shown that too little air movement lowers this threshold of sensitivity. —HENRY WRIGHT, Technical Consultant.

FUEL CONSERVATION COST AT BOEING

REGARDING E. A. TYLER'S comments in the June HPAC regarding the cost of the fuel conservation program at Boeing, the figure of $1200 a month for the additional labor is somewhat misleading as this figure covers considerable other inspection work. Perhaps about $400 a month would be a fair charge against the resulting savings.

Mr. Tyler made a very logical statement which briefly answers the overall problem of fuel conservation when he said "There is no magic formula — just a lot of hard work and detailed study in the application of common-sense to elimination of leaks."

I think the article in the May HPAC on our fuel conservation program was a very fine job.—WILLIAM B. PRIDE, Heating and Ventilating Engineer, Boeing Airplane Co.

SIZING PIPING FOR HOT WATER HEATING

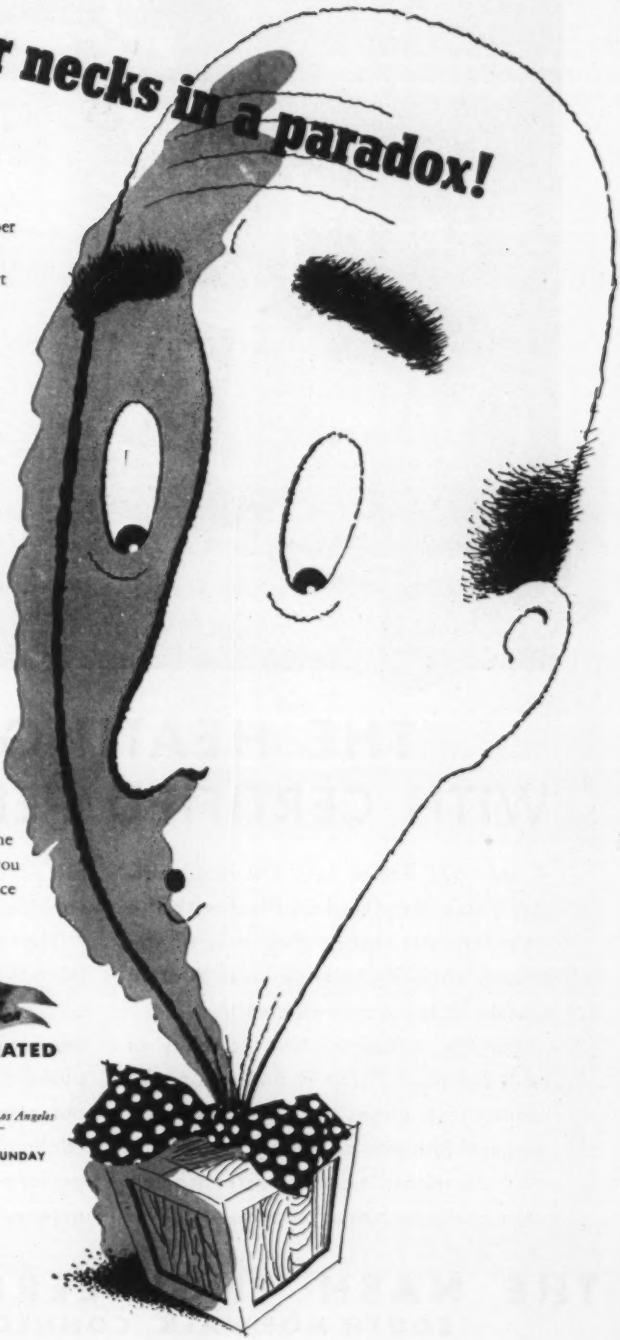
WE WERE VERY MUCH interested in the discussion in the June HPAC by E. A. Kaplun concerning the pipe sizing methods used in Germany. This is a very fine article and the conclusions are in agreement with our general belief.

There are other things brought out by this question that might bear a little bit of verification. Basically, the ASHVE Guide, due to the space problem, is faced with the necessity of limiting the information it publishes to quite an extent. Such being the case, it becomes impossible to supply all of the information which might be desirable on any subject.

The methods outlined by the ASHVE Guide for hot water pipe sizing are capable of considerable amplification within the basic structure given. Those of us who are primarily concerned about this information have built up considerably beyond the illustrations that are given in the Guide. Even so, the basic information is all there, if one wants to work it up into shape.

It would be interesting to know how many folks we have in the country that are actually interested sufficiently so that the amplification of design procedure possible would be advisable.—H. A. LOCKHART, Chief Engineer, Bell & Gossett Co.

we're up to our necks in a paradox!



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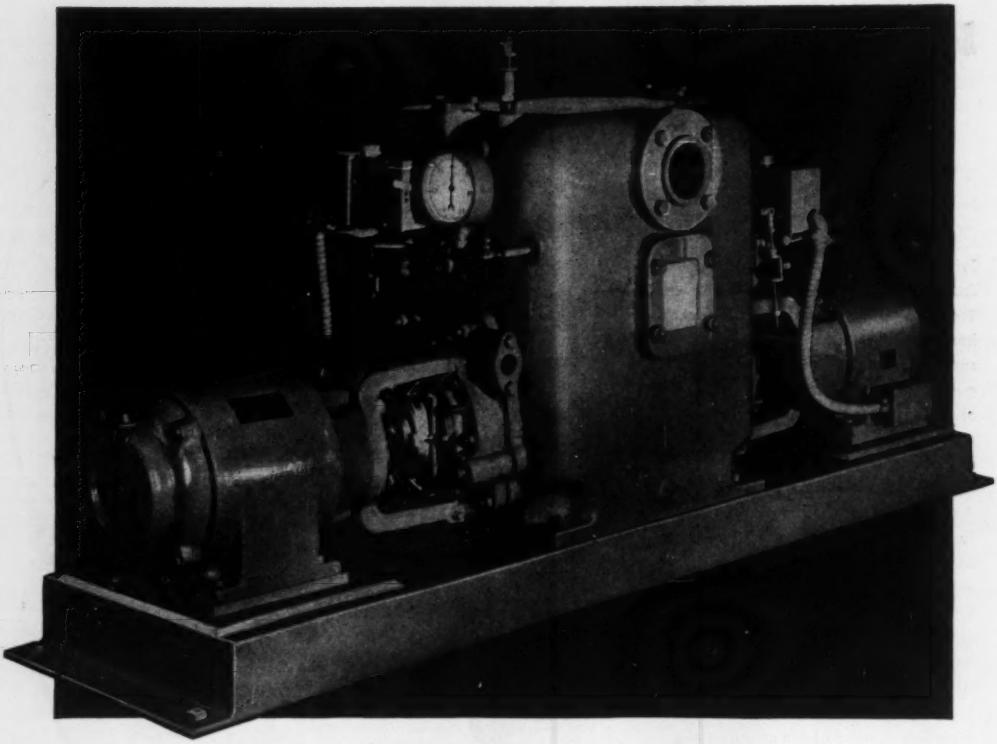

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Short-Cut Method Aids Figuring Exhaust and Collecting Systems

By W. H. Fogle, Mechanical Engineer
Western Electric Co.

A simple, workable method of determining static losses in industrial exhaust and collecting systems is explained here by means of a sample problem and its step-by-step solution. The method might be described as an "averaging out" process, whereby all duct sizes and lengths are averaged out with the cfm and velocity to give a total linear footage of the average duct size and an average velocity

MANY EXCELLENT technical articles on various methods of calculating total static resistance in industrial exhaust and collecting systems have been published. It is not the author's intent to criticize these methods but to demonstrate a simple, workable solution to problems of this type which does not involve volumes of arithmetical calculations and formulas.

The methods previously described have delved deeply into velocities, cfm's, entrance losses, offset losses, hood losses, etc. Yet when the final solution (that is, total static resistance to be overcome and total cfm to be obtained) has been reached, the invariable result is to select a fan and motor that will produce slightly greater cfm and static pressure in order to be on the safe side.

Actually, all theoretical conditions in these aforementioned calculations might be true if the following conditions were also true at the same time:

1) The room conditions at the exhaust hood and the outside air are at standard air conditions (70 F dry bulb and 29.92 in. of mercury barometric pressure).

2) No stray air currents exist at the hood.

3) All joints and connections are in absolute alignment.

4) There are no air currents on the outside of the building.

5) The exhausted air does not change in temperature or weight from the time it enters the exhaust hood to the time it leaves the roof vent.

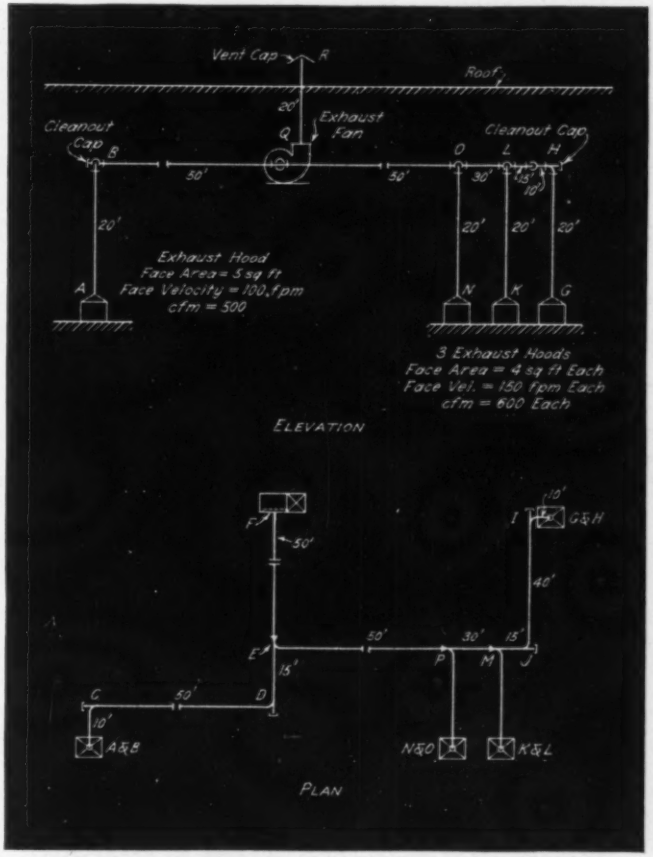


FIG. 1 — SAMPLE EXHAUST LAYOUT used in text to explain application of "short cut" method of calculation

TABLE 1 — SHORT METHOD of determining static pressure in exhaust system. Numbers in parentheses refer to the various steps

Select velocity (fpm) and volume (cfm) of air to be exhausted.
Select longest run in system (largest static pressure).
Start calculations at exit of exhaust hood.

No. of ft of duct leading from exhaust hood x size of duct = _____
No. of ft of next size larger duct x size of duct = _____
No. of ft of next size larger duct x size of duct = _____

(1) Total (2) Total = (3) Total

Equivalent number of feet of duct for:

Elbows = (4)
Bends = (4)
Enlargements = (4)
Fan and exhaust cap is equivalent to three 90 deg elbows = (4)
(5) Total

(4) x dia. of elbow = _____
(4) x dia. of bend = _____
(4) x dia. enlargement = _____
(4) x fan = _____
(6) Total

(1) Total + (5) Total = (7) Total
(3) Total + (6) Total = (8) Total
(8) Total ÷ (7) Total = *Average size of duct*

[(7)/100 ft] (at velocity in duct) = _____ in. static pressure (chart)
VP (velocity pressure at velocity in duct) = _____ in. static pressure (table)
Drop in hood (0.2) = _____ in. static pressure
GRAND TOTAL

From Grand Total select fan and motor

TABLE 2 — Duct sizes for Fig. 1

Location	Cfm	Duct area necessary (based on 2000 fpm velocity), sq ft	Duct diam., in.
A	500	0.25	7
G	600	0.30	8
K	600	0.30	8
N	600	0.30	8
J to *M*	600 to 1200	0.30 to 0.60	11
M to *P*	1200 to 1800	0.60 to 0.90	13
E to *F*	1800 to 2300	0.90 to 1.15	15
Q to *R* (same as fan inlet)	2300	1.15	15

TABLE 3

Duct location	Length of run	×	Duct size	=	Factor
G to *H*	20′-0		8		160
H to *I*	10′-0		8		80
I to *J*	40′-0		8		320
J to *M*	15′-0		8		120
M to *P*	30′-0		11		330
P to *E*	30′-0		13		650
E to *F*	50′-0		15		750
Q to *R*	20′-0		15		300
Totals	235′-0		86		2710
	(1)		(2)		(3)

TABLE 4 — RESISTANCE TO AIR FLOW in elbows and bends in equivalent duct length (ft). Center line radius equals 2.5*d* and equivalent duct length equals 0.00780 $d^{1.2}$ (from Industrial Health Engineering, by Allen D. Brandt)

Duct diam.,	Degree of bend				
in.	15	30	45	60	90
3.0	0.4	0.9	1.3	1.7	2.6
3.5	0.5	1.0	1.6	2.1	3.1
4.0	0.6	1.2	1.8	2.4	3.6
4.5	0.7	1.4	2.1	2.8	4.2
5.0	0.8	1.6	2.4	3.2	4.8
6.0	1.0	2.0	3.0	4.0	6.0
7.0	1.2	2.4	3.6	4.8	7.2
8.0	1.4	2.8	4.2	5.6	8.5
9.0	1.7	3.2	4.9	6.6	9.8
10.0	1.9	3.7	5.6	7.5	11.2
11.0	2.2	4.2	6.3	8.5	12.6
12.0	2.4	4.7	7.0	9.4	14.0
13.0	2.6	5.1	7.7	10.4	15.4
14.0	2.9	5.6	8.4	11.3	16.9
15.0	3.2	6.1	9.2	12.3	18.4
16.0	3.4	6.6	9.9	13.3	19.9
17.0	3.7	7.2	10.7	14.3	21.5
18.0	3.9	7.7	11.4	15.3	23.0
19.0	4.2	8.2	12.2	16.3	24.5
20.0	4.4	8.7	13.0	17.3	26.0
21.0	4.7	9.2	13.8	18.4	28.0
22.0	4.9	9.7	14.5	19.4	29.0
23.0	5.2	10.2	15.3	20.4	31.0
24.0	5.4	10.7	16.1	21.4	32.0
25.0	5.7	11.3	16.9	22.5	34.0
26.0	5.9	11.8	17.7	23.6	35.0
27.0	6.2	12.3	18.5	24.7	37.0
28.0	6.5	12.9	19.3	26.0	39.0
29.0	6.8	13.4	20.1	27.0	40.0
30.0	7.1	13.9	20.8	28.0	41.0
36.0	8.6	17.2	26.0	34.0	52.0

6) There is no corrosion on the insides of the ducts, hoods or fans after continuous usage over a period of years.

It is reasonable to assume that it is almost impossible for any two of these conditions to exist at any one time.

The "short method" discussed here of determining the static pressure to overcome in an exhaust system is best described as an "averaging out" process. All duct sizes and lengths (including elbows, offsets, transitions, etc.) are averaged out with the cfm and velocity to give a total linear footage of the average duct size and an average velocity. The loss through the fan and exhaust cap is considered to be equivalent to three 90 deg elbows and an allowance of 0.2 in. water is added as the hood entrance loss. This is adequate except in cases of extremely high face velocities at the hood (i.e., over 1500 fpm).

If the hood face velocities are over this figure, it is advisable to consider them as a separate problem and add the calculated resistance (rather than to use 0.2 in. water) to the calculations shown.

Basically, the steps to be taken in the short method are shown in Table 1. This is followed by a typical layout with accompanying calculations.

Sample Calculation Shows Details

From the sample exhaust layout shown in the elevation of Fig. 1, it will be noted that the total air to be exhausted is 500 cfm + 3 × (600 cfm) = 2300 cfm. It will also be noted that the farthest hood from the fan is at *G*. Assuming the contaminants to be exhausted are fumes from soldering and welding operations, we will use a duct velocity of 2000 fpm to keep the size of the ducts comparatively small. By maintaining a constant duct velocity of 2000 fpm, the ducts are sized as shown in Table 2.

Since friction losses are to be overcome at the farthest hood from the fan (*G* on elevation of Fig. 1) it follows that the lesser friction losses nearer the fan will automatically be taken care of in the calculations. Therefore, starting with the first step in Table 1, we get the values shown in Table 3.

The next step is to count the number of transitions, elbows, offsets, etc., from the last hood up to and including the fan and the vent cap on the roof. The air direction through the fan is changed twice hence the fan is credited with two elbows and the roof cap with one elbow. Therefore, the equivalent number of feet of duct for the air flow interferences would be (using the data from Table 4) as shown in Table 5.

From Table 3 and Table 5:

Step No. 1 (235) plus Step No. 5 (127.1) equals Step No. 7 (362).

From Table 3 and Table 6:

Step No. 3 (2710) plus Step No. 6 (1646) equals Step No. 8 (4356).

Step No. 8 divided by Step No. 7 equals average duct size:

4356 divided by 362 equals 12 in., the average duct size.

Checking an air friction chart for round pipe, it is found that the static resistance of air at a velocity of 2000 fpm in a 12 in. duct is 0.47 in. of water per 100 ft of duct (see ASHVE 1951 Guide, page 657). Since the total theoretical run is (Step 7) 362 ft, then the total static resistance is (362/100) × 0.47 = 1.70 in. To this figure must be added the velocity pressure at 2000 fpm (see Table 7) or 0.25 in. of water, and the loss at the hood (assumed to be 0.2 in.) Therefore, 1.70 plus 0.25 plus 0.2 equals 2.15 in., which is the total static resistance to be overcome in the system. The exhaust fan selected should therefore develop at least 2300 cfm at 2.5 in. SP.

It is generally good practice to use a belt driven fan with slightly greater capacity and horsepower than that arrived at by the above calculation in order to take care of unforeseen offsets or transitions that might occur in the field. In this case the fan selected should have a top performance of about 2500 cfm at 3.0 in. SP.

Actual Installation

Using the Method

This short method of calculating exhaust systems is not infallible in any sense of the word but is excellent for the usual type of manufacturing operation. A good example of an actual installation using the aforementioned system is illustrated in Figs. 2 and 3. This is an exhaust and collecting system in which the main header increases in diameter

TABLE 5

Step no.	No. used	Item	Location	Size	Angle of entry, deg	Equiv. length, ft
4	1	Elbow	H	8"	90	8.5
4	1	Elbow	I	8	90	8.5
4	1	Elbow	J	8	90	8.5
4*	1	Transition	M	11	90	12.6
4*	1	Transition	P	13	90	15.4
4†	1	Elbow	E	15	90	18.4
4	3	Elbows	F,Q&R	15	90 x 3	55.2
					(Step No. 5)	127.1

*Size of transition is considered on downstream side.
†Where a transition and elbow occur at the same location, then only one is considered.

TABLE 6

Duct diam., in.	×	Equivalent length of run, ft	=	Factor
8		8.5		68.0
8		8.5		68.0
8		8.5		68.0
11		12.6		138.6
13		15.4		200.0
15		18.4		276.0
15		55.2		828.0
				1646 (Step No. 6)

TABLE 7 — VELOCITY PRESSURES for different velocities (taken by permission from Industrial Ventilation — A Manual of Recommended Practice, published by the American Conference of Governmental Industrial Hygienists, January 1951)

$$\left[VP = \left(\frac{V}{4005}\right)^2\right]$$

[Velocity (V) in feet per minute and velocity pressure (VP) in inches of water]

VP	V	VP	V	VP	V	VP	V	VP	V	VP	V
0.06	981	0.43	2626	0.80	3582	1.17	4332	1.54	4970	1.91	5535
0.07	1060	0.44	2656	0.81	3604	1.18	4350	1.55	4986	1.92	5550
0.08	1133	0.45	2687	0.82	3625	1.19	4368	1.56	5002	1.93	5564
0.09	1201	0.46	2716	0.83	3657	1.20	4386	1.57	5018	1.94	5579
0.10	1266	0.47	2746	0.84	3669	1.21	4405	1.58	5034	1.95	5593
0.11	1328	0.48	2775	0.85	3690	1.22	4423	1.59	5050	1.96	5608
0.12	1387	0.49	2804	0.86	3709	1.23	4442	1.60	5066	1.97	5623
0.13	1444	0.50	2832	0.87	3729	1.24	4460	1.61	5082	1.98	5637
0.14	1498	0.51	2860	0.88	3758	1.25	4478	1.62	5098	1.99	5651
0.15	1551	0.52	2888	0.89	3779	1.26	4495	1.63	5114	2.00	5664
0.16	1602	0.53	2916	0.90	3800	1.27	4513	1.64	5129	2.01	5678
0.17	1651	0.54	2943	0.91	3821	1.28	4531	1.65	5144	2.02	5692
0.18	1699	0.55	2970	0.92	3842	1.29	4549	1.66	5160	2.03	5706
0.19	1746	0.56	2997	0.93	3863	1.30	4566	1.67	5175	2.04	5720
0.20	1791	0.57	3024	0.94	3884	1.31	4583	1.68	5191	2.05	5734
0.21	1835	0.58	3050	0.95	3904	1.32	4601	1.69	5206	2.06	5748
0.22	1879	0.59	3076	0.96	3924	1.33	4619	1.70	5222	2.07	5762
0.23	1921	0.60	3102	0.97	3945	1.34	4636	1.71	5237	2.08	5776
0.24	1962	0.61	3127	0.98	3965	1.35	4653	1.72	5253	2.09	5790
0.25	2003	0.62	3153	0.99	3985	1.36	4671	1.73	5268	2.10	5804
0.26	2042	0.63	3179	1.00	4005	1.37	4688	1.74	5283	2.11	5817
0.27	2081	0.64	3204	1.01	4025	1.38	4705	1.75	5298	2.12	5831
0.28	2119	0.65	3229	1.02	4045	1.39	4722	1.76	5313	2.13	5845
0.29	2157	0.66	3254	1.03	4064	1.40	4739	1.77	5328	2.14	5859
0.30	2193	0.67	3279	1.04	4084	1.41	4756	1.78	5343	2.15	5872
0.31	2230	0.68	3303	1.05	4103	1.42	4773	1.79	5359	2.16	5886
0.32	2260	0.69	3327	1.06	4123	1.43	4790	1.80	5374	2.17	5899
0.33	2301	0.70	3351	1.07	4142	1.44	4806	1.81	5388	2.18	5913
0.34	2335	0.71	3375	1.08	4162	1.45	4823	1.82	5403	2.19	5927
0.35	2369	0.72	3398	1.09	4181	1.46	4840	1.83	5418	2.20	5940
0.36	2403	0.73	3422	1.10	4200	1.47	4856	1.84	5433	2.21	5954
0.37	2436	0.74	3445	1.11	4219	1.48	4873	1.85	5447	2.22	5967
0.38	2469	0.75	3468	1.12	4238	1.49	4889	1.86	5462	2.23	5981
0.39	2501	0.76	3491	1.13	4257	1.50	4905	1.87	5477	2.24	5994
0.40	2533	0.77	3514	1.14	4276	1.51	4921	1.88	5491	2.25	6008
0.41	2563	0.78	3537	1.15	4295	1.52	4938	1.89	5506		
0.42	2595	0.79	3560	1.16	4314	1.53	4954	1.90	5521		

FIG. 2 — "SHORT CUT" METHOD explained in text was used in design of this exhaust and collecting system which picks up chips and dust from grinding, scratch brushing and buffing operations

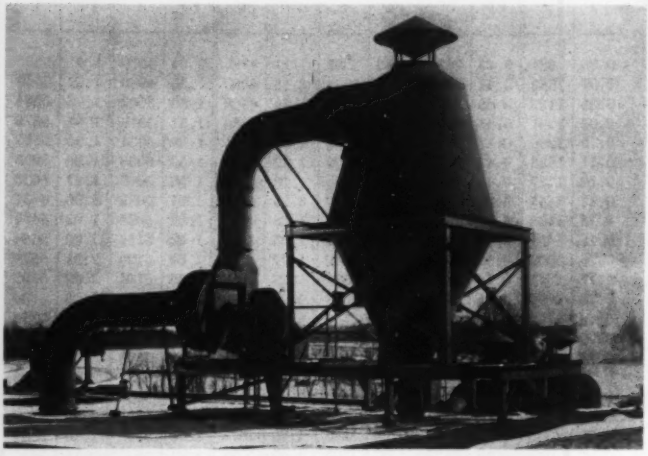


FIG. 3 — MAIN DUCT PASSES through roof into 50 hp exhaust fan and thence to cyclone separator. Duct velocities in this installation were held to a minimum of 4000 and a maximum of 4500 fpm

toward the end of the run as it picks up chips and dust from grinding, scratch brushing and buffing operations. Each vertical branch drops to a bench and runs horizontally under the benches picking up dust and chips from down draft hoods on the benches. The main duct passes through the roof into a 50 hp exhaust fan, and thence to the cyclone separator where the dust and chips drop out through the bottom of the separator and the air is relieved through the top.

In this particular installation, the duct velocities were held to a minimum of 4000 fpm and a maximum of 4500 fpm in order to convey the larger particles. With air flows of this velocity and magnitude, it is quite important to isolate the collector and fan, and provide other means of dampening out air noise and vibration. This was accomplished in this particular installation by heavy canvas connections between the fan and collector, a muffler above the fan and shock mounts on the equipment on the roof.

APARTMENT TENANTS WANT HEAT CONTROL

APARTMENT DWELLERS prefer to live in apartments where they can regulate their own heat and would even be willing to pay extra for the privilege, according to a recent study of the public's heating attitudes.

More than 40 percent of those interviewed in over 100 cities and towns said they would pay as much as $5 extra per month to live in apartments featuring personalized heat control.

The survey was conducted for the Minneapolis-Honeywell Regulator Co. by an independent research organization.

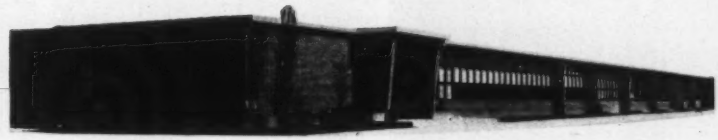
A common complaint was that rooms or parts of the apartment were too hot or too cold.

John E. Haines, vice president of the company, pointed out that building managers not only add to tenant comfort by installing a thermostat in each apartment, but can save up to 18 percent on the building's annual fuel bills.

ASTM APPROVES INSULATION STANDARDS

THE STANDARDS COMMITTEE of the American Society for Testing Materials has approved a tentative specification for mineral wool blanket insulation (C 263-51 T) which covers the composition, dimensions and physical properties of metal mesh covered insulation intended for heated surfaces. The specification states that "the blanket insulation shall consist of units each composed of mineral wool fibers without binders added, covered by flexible metal fabric facings and held together by heat-resistant ties extending through from one face to the other. The mineral wool shall be rock, slag or glass processed from a molten state into fibrous form."

In addition, tentative specifications for mineral wool industrial batt insulation (C 262-51 T) and for mineral wool felt insulation (C 264-51 T) were approved.



Hot and Cold Ducts Feature Direct Fired System for School

Howard A. Vernay, Jr., sales engineer in the New York office of the Dravo Corp. heating department, describes the direct fired warm air heating and ventilating system for a modern New Jersey school. Two air supply ducts furnish 130 deg and 70 deg air to each classroom, and each room has an air mixing register to blend air from these hot and cold ducts in accordance with demands of the room thermostat. The method has been found to be flexible and economical

BY INTEGRATING a combination heating and ventilating system with the basic architectural design of a modern school building, a New Jersey architectural firm has achieved some unusual results from the standpoints of economy and performance.

The procedure followed by Jay C. Van Nuys, AIA, Somerville, N. J., architect, reversed the conventional practice of making the heating and ventilating system "fit" the building plans after the latter are completed.

Recognizing the importance of maintaining comfortable temperatures in school classrooms and keeping the initial cost within the budget, the architect collaborated with Raymond Althoff, consulting mechanical engineer, also of Somerville, before designing the consolidated elementary school for Hillsborough township, Somerset county, N. J. Economy of the heating and ventilating system selected for the school was one of the contributing factors that permitted its completion within budgetary and statutory debt limitations without sacrificing essential construction or architectural features of the modern building.

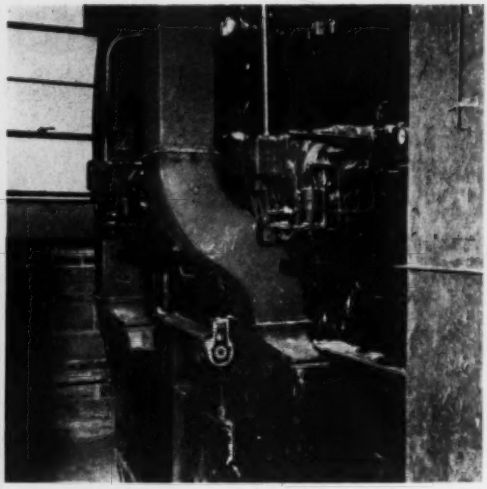
By literally "building the school around" the direct fired warm air heating and ventilating system, the entire installation cost approximately 81 cents per sq ft of the building. Installed cost of the heating and ventilating system was less than 7 percent of the total cost of the building including landscaping, site development, kitchen equipment and all other essentials except furniture for the classrooms.

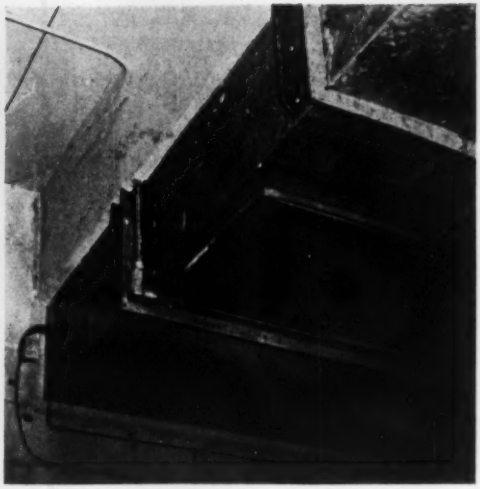
With the system used, every room in the building — there are 14 classrooms, plus offices, clinic, library, restrooms, kitchen and a combination cafeteria-assembly hall — is supplied with a constant volume of 100 percent outside filtered air during school hours. A unique method of blending hot and cold air as it enters each room solves the problems of temperature control. This takes care of temperature fluctuations caused by solar heat gains, lighting fixtures and the sensible heat given off by classroom occupants. Furthermore, it is not necessary to open windows or doors for ventilation.

Two 1,750,000 Btu Heaters Used

One main problem confronting the designers was how to warm sufficient volumes of outdoor air for the ventilating requirements which, in a school building, are a vital consideration. This problem was overcome by the use for the entire system of two direct fired space heaters, each having an output capacity of 1,750,000 Btu per hr. These two units handle the job of heating some 20,000 cfm of outdoor air.

The school building is a one story, L-shaped structure with a frontage of 389 ft containing approximately 28,214 gross sq ft. The base of the L is occupied by two of the classrooms, the 29 ft by 39 ft kitchen and the 61 ft by 50 ft cafeteria-assembly hall. Classrooms and offices flank a 10 ft wide corridor along the leg of





BURNER SIDE (*left*) of the two direct fired heaters. The burners are controlled by a ductstat in the supply air duct. . . . . TWIN DUCTS (*right*) from the heater room into the supply air chambers above corridor. Insulated "hot" duct with 130 deg air is on top and "cold" duct with 70 deg air is on the bottom

the L. Average classrooms are 33 ft by 21 ft and 39 ft by 21 ft. Ceilings are all 12 ft high. Kindergarten children and pupils in the first two grades are separated from the rest of the building at one end of the corridor in larger classrooms especially designed for them. This prevents other pupils from being distracted by the noise and confusion of the lower grades.

Every classroom opens to an outside terrace, a feature which permits complete evacuation of the building within 30 sec.

The heating and ventilating system utilizes dead space over and under the main corridor for air ducts. Under the corridor is a tunnel 10 ft wide by 4 ft deep that receives air exhausted from the rooms. At each end of the tunnel, a 10,000 cfm blower discharges air to the outside. A 4 ft by 5 ft dampered opening from this tunnel into the air supply plenum chamber under the heater room, however, permits automatic operation of the system on recirculated air during periods of non-occupancy. This conserves fuel.

The ceiling of the main corridor has been furred down — as it would have been anyway — to provide a space 10 ft wide by 3 ft high, leaving the corridor 9 ft high. This air space in the false ceiling is divided into two chambers by continuous steel decking insulated with 1½ in. of insulating concrete. The decking is supported by angle bars set in the 8 in. concrete block corridor walls. These two chambers are air supply ducts for the classrooms, one carrying 130 deg air and the other 70 deg air, and are known as the "hot duct" and "cold duct", respectively.

A constant volume of air is taken from these supply ducts at ceiling height in each room. Manually set volume dampers at each outlet balance the air flow throughout the system. Each room has an air mixing register to blend air from the hot and cold ducts in accordance with the demand of a room thermostat. The thermostat controls a small air motor that operates the dampers through double linkage. This assures a constant volume of air at whatever temperature is required to maintain comfortable conditions in the individual rooms. The registers diffuse the air to the right and left to establish uniform distribution.

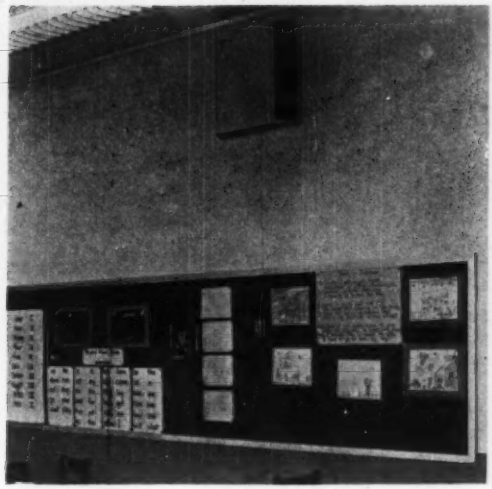
Slotted Openings for Exhaust Air

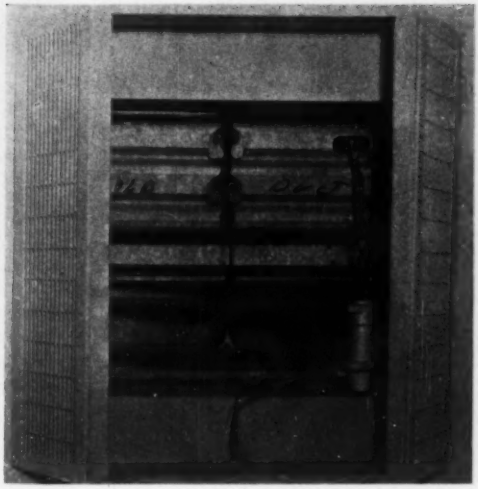
Along the exterior wall and one side wall, there are slotted continuous openings in the floor for removal of air from each room. The 1½ in. openings along the exterior wall are behind built-in bookcases 12 in. deep. Along the side wall, the 4 in. floor openings are inside clothes lockers. Locker doors are left open 4 in. at the top to allow entry of ventilating air in accordance with state code requirements.

Exhaust air drawn into the slotted openings flows under the steel deck flooring and empties into the corridor tunnel through the cells of every third cinder block which has been laid horizontally along the top course. This eliminates the need for ductwork. While the exhaust air has no functional heating purpose, it does help to keep the floor warm.

The flooring of the building consists of steel decking laid on 6 in. by 6 in. concrete beams. This provides a 6 in. air space in addition to the space in the channels of the floor decking. Angle irons are set in the concrete beams and the decking is welded to them. On top of the decking is asphalt tile finish flooring.

The roof of the building is steel decking topped by 1½ in. of rigid insulation and a five-ply felt tar and gravel covering. The roof overhangs the windows 2 ft, 7 in. An 8½ in. aluminum flashing gives the building a pleasing, modern architectural appearance. The 3 ft by 3 ft redwood window frames support the roof, eliminating need for lintels. Each classroom has two-thirds window area in the exterior wall. The windows are in the air flow path since exhaust openings are below them. Warm air continuously "wipes" the windows to keep them from fogging.





INTERIOR WALL *(left)* of a typical classroom. Air diffuser supplies constant volume of air, mixed automatically to maintain desired temperatures according to thermostat demand. . . . . CLOSEUP OF AIR blending discharge outlet *(right)* used in each room. Room thermostat controls an air motor that operates double linkage dampers on hot and cold ducts

Partition walls between classrooms are of 4 in. concrete block projected out the exterior wall 2 ft. 7 in. These projecting partitions serve as fire stops and enhance the modern design. Ceilings of all rooms are accoustical tile. Lighting is fluorescent. Each classroom is equipped with an abundance of tackboards, chalkboards, storage facilities and work space.

How the System Is Controlled

Using a program clock control arrangement, the heating and ventilating system operates automatically day by day and week by week. The school's janitorial staff takes care of what few adjustments have to be made to the system.

The controls are set so 20,000 cfm of outdoor air is brought in, heated and delivered to the rooms continuously. The outdoor air intake opening, 4 ft by 5 ft, has a pneumatically controlled damper through which air passes only during the outdoor air operating cycle. The air is drawn into a plenum chamber through a 12 ft by 7 ft bank of filters and forced upward by the 20,000 cfm fan into the bases of the two oil fired heaters, mounted on the floor above the chamber. Part of the air is bypassed around the heaters to be used in making up the cold duct supply. The remainder enters the base of each heater, is passed over banks of economizer tubes carrying flue gases to the stack and then sweeps the heater's stainless steel combustion chamber. It discharges directly into the insulated hot duct. Thermo statically controlled motor operated dampers bleed some of this hot air to mix with cold air for the 70 F cold duct. The hot duct contains a thermostat which controls the burners of both heaters to obtain 130 deg air. A humidifier is installed in the duct for use as needed.

After school hours, the program clock reverses this operating cycle. The outdoor air intake damper closes, the return air damper opens, the two exhaust blowers at either end of the tunnel are shut off and the system operates on 100 percent recirculated air.

The flexible arrangement can be operated on a mixture of outdoor and recirculated air, if desired. It is designed primarily, however, for 100 percent outdoor air operation down to 0 deg. If the outdoor temperature should drop below zero, some recirculated air can be used.

The only ductwork required for the entire system is that used in the heater room, two small runs into the cafeteria-assembly hall and one hot duct for the kitchen.

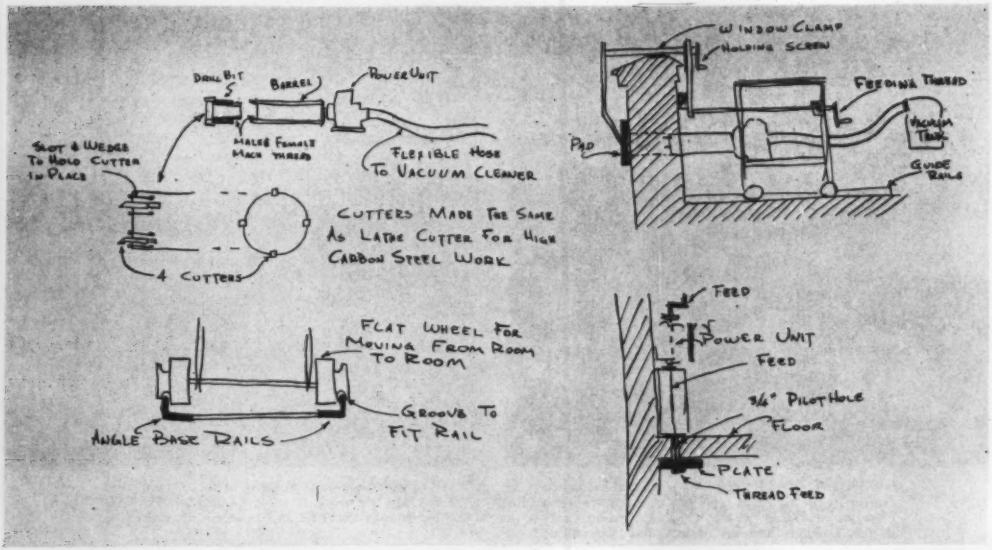
COOLING LESS EXPENSIVE THAN VENTILATION

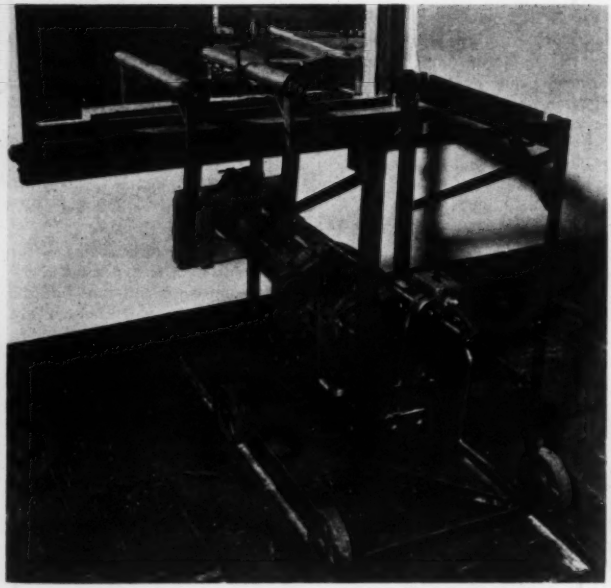
USE OF AIR conditioning proved less expensive than ventilating due to unusual heat conditions in the shipping room of a men's furnishings manufacturing plant in Darby, Pa. The shipping room in the Pioneer Suspender Co. plant is over large basement boilers, has three walls of glass, and is divided into aisles by steel stock bins which hinder air circulation. Floor temperatures in the 9000 sq ft room ran as high as 125 deg due to heat from the boilers below.

Calculations showed that an air conditioning system utilizing a 30 ton packaged unit could be installed to provide comfort cooling at a cost considerably below the estimate for ventilation, while meeting tight equipment space requirements at the same time, according to the United States Air Conditioning Corp.

As designed and installed by Air Conditioning Associates, Inc., the system places the unit in an adjacent equipment room, with ductwork connecting to the shipping room. Satisfactory air distribution is provided by a grille at each of the aisles formed by the stock bins.

The system utilizes 15 percent outdoor air, obtained through a short duct run from the rear outside wall.





HOLE DRILLING MACHINE simplified the air intake installation. Its power unit is a 4 in. standard threading machine set upon a cradle that has adjustment up or down only. The drill bit barrel is made of extra heavy 5 in. pipe, 30 in. long, threaded with fine machine threads on one end. Into these fit the actual drill bit. The whole frame assembly is on flat steel wheels with grooved hubs to fit standard ¼ x ¼ x 2 angles to form guide rails for holding into position. A clamp fits over the window sill to perform two functions: (1) the feeding screw to pull the bit into the cut was attached to this, and (2) a pad on the outside prevented the core from being pushed out and falling to the street below. . . . . For drilling vertically, the machine was redesigned with a similar wheeled base that allowed it to be moved right against the wall. A pilot hole of ¾ in. diameter was drilled first through which was run the feed screw to a plate below. The machine was then forced downward. . . . . As shown in exterior view of building, air intakes under each window — holes for which were drilled by this machine — are of pleasing appearance

Machine Drills Air Intakes for Room Conditioning Units

By Will D. Sampson

There are many methods of air conditioning an existing building, one of them being with individual room units — each with its air intake — supplied with chilled or heated water from a central source. This scheme was used in the case described here. Among several features of the job was a special machine for drilling holes through the building walls for the air intakes and through the floors for the piping. The author was manager of the Air Conditioning Div., Alamo Lumber Co., when this installation was made, is now principal of Will D. Sampson & Associates

THE SOUTH TEXAS building, in San Antonio, is a 12 story office structure tenanted by high class businesses, doctors, dentists, and law firms which was recently air conditioned.

A room unit system — with fans, coils and filters in the individual units — was selected as there was no space available for duct work and because individual control of each office was desired. Three 100 hp compressors in the penthouse supply refrigerant to the water chillers. A system of copper piping distributes the water to the units in each office. Heating is by steam from existing boilers in the basement to a heat exchanger in the penthouse which heats the circulating water.

Each of the 365 room units has a three-speed fan and a hand valve which allows each tenant control of the temperature within his suite.

Hole Drilling Machine for Air Intakes

Outside air is supplied each unit through the wall under each window. Cutting this hole presented a very interesting problem. To remove several bricks under the sill would run the costs entirely too high, and on some of the floors the spandrel is of terra cotta — which would have meant complete removal. We designed a machine to drill a 5 in. hole from inside the building.

This machine drills a cored hole through 15 in. of tile, concrete, steel bars, terra cotta or face brick in 12 minutes. The hole is so smooth no interliner is necessary and neither the plaster on the inside nor the face brick are chipped by the cutters. The dust and chips of the cut are withdrawn through the center of the drill bit with an industrial vacuum cleaner — which eliminated need for drop cloths to prevent spoilage of furnishings.

Modifications were made to this machine so it could be used to drill the vertical holes for the pipe risers. Since a clean hole of exact size could be drilled, it was possible to keep the riser system close to the walls and partitions so as to use the minimum floor space.

The outside air intakes are covered with aluminum weather heads and bird screens of attractive design. They present a very pleasing appearance from the street or from other buildings nearby.

Exhaust air from each room passes to the corridors through the openings left by removal of the transoms. Sheet metal louvers were built which extend the entire lengths of the corridors and add greatly to the appearance as the horizontal lines give the effect that the building is 20 or 30 ft longer than it is.

This exhaust air is then removed through the toilets on each floor to an axial flow fan installed on the roof, where it is discharged to atmosphere.

Furniture Steel Piping Enclosures

Space requirements were the basis of the design, and this theme was followed through when forming the pipe chases or furring in each set of risers. There are 12 sets of risers throughout the building each consisting of a supply and return pipe, a condensate drain pipe and an electric conduit to supply power to each fan. These were grouped so that the two large pipes are on the outside, with the drip and electric conduit filling the space between.

Furniture steel is used to enclose these risers. The design is in three parts — top, bottom and mid-section. In this way we saved difficult forming angles and simplified installation. By the use of furniture steel we saved $2\frac{1}{2}$ to 3 in. on each dimension. The furred risers are so compact that unless you know where they are, you have difficulty in recognizing them.

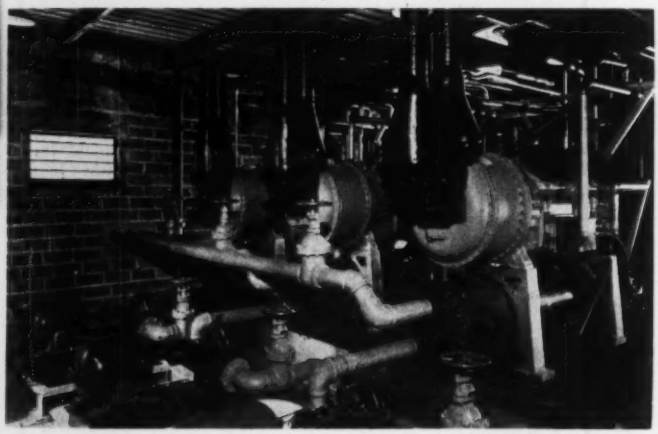
Runout Pipes Behind Baseboards

The runout pipes to each unit are behind the wood baseboards. The baseboards were removed, the pipes put in, and a metal bracket in the form of a "U" installed to which the wood baseboards were screwed. The space between the wall and baseboard was covered by the same material used on the risers.

Where it is necessary to run piping across ceilings to get to internal units, pipe hangers of special design are used that allow the metal furring to completely cover the entire assembly. This neat and compact metal chase, when painted to match the ceiling, blends completely.

Future air conditioning changes

SHEET METAL LOUVERS extend entire lengths of corridors, provide for exhaust air from each room through openings left by removal of transoms. These two views show "before" and "after"



THREE 100 HP COMPRESSORS in penthouse supply chilled water to 365 room units throughout building. Each unit has three-speed fan, coil, filter and outside air intake

which will occur with new tenants or additions to suites may be done without great expense for the furring. There will be no need for plastering or patching.

In the overall picture, the saving in total floor space made by this design was such that no allowance was necessary for rebate of space to the tenants. All the new equipment was installed practically within the same area taken up by the old steam piping and radiator system that formerly heated the building. General construction work was held to the minimum.

FAULTY WEATHER CAPS IMPAIR SPRAY BOOTHS

A PLANT WHICH had just begun the manufacture of wooden radio cabinets sent a rush call to the Division of Industrial Hygiene of the Federal Security Agency's Public Health Service, the division's publication, Industrial Health Monthly, reports. The problem was that 10 spray booth systems to remove paint vapor and mist had been installed but some of the booths were discharging contaminated air back into the workroom.

Investigation showed that the workmen were spraying properly—that is, standing upstream from the work and directing the spray guns onto the work at an angle so that the overspray ricocheted downstream toward the rear of the booth. The air distributing baffles were installed properly, fans were mounted correctly, rotation was in the right direction, and horsepower and speed were adequate. Air velocity measurements revealed good air movement into the booths except at the sides where the air movement was outward, carrying with it vapor and mist from the spraying operations.

The industrial hygiene engineers, having eliminated the booth and its inside piping from possible blame, decided to examine the discharge piping on the roof. There they discovered that the weather caps on the faulty spray booths had been installed practically flush with the discharge pipe, creating a high back pressure, while the caps on the properly functioning spray booths were installed correctly. The cap installation was corrected on the spot and a recheck of the booths revealed them to be functioning properly.

Ventilation of Survival Areas for Civil Defense

By Howard C. Murphy

The author — a consulting engineer, and a member of HPAC's board of consulting and contributing editors — has had a wide experience in air filtering and air conditioning, and has recently been active in engineering aspects of civil defense problems. To complete his earlier article on the subject in the May HPAC, he discusses this month information which has recently become available on removal of radioactive particles from air streams

THE ATOMIC ENERGY Commission has recommended (see The Effect of Atomic Weapons, Government Printing Office, Washington, D.C.) the Chemical Warfare Service No. 6 filter for large quantities of air. A comparable material (see Chemical Engineering, 57, 8, 105, August 1950) has been developed for the AEC to handle radioactive and other "absolute" air filtering requirements. It has been stated that efficiencies better than 99 percent on 0.3 micron oily aerosols can be obtained by the particle count method with such filters. Resistance to air flow of a unit 24 in. by 24 in. by 6 7/8 in. deep is said to be 1 in. at 500 cfm.

It is recommended that these filters be protected by precleaners, in which case it is stated the filters will operate more than 12 months on a 24 hr basis before the resistance doubles. Without precleaners, it is stated that the useful life of the filter against atmospheric dust would be only a few months, the actual time varying with the amount of dust in the air.

Considerable reliance has been placed on dry type filters consisting of loosely aggregated fibers of wool, cellulose, glass, rock wool and various other natural and synthetic fibers. The spaces between the fibers are naturally much larger than the particles it is wished to remove, which are sometimes of the order of 0.1 micron. The removal of these air impurities therefore depends not upon "screening" but largely upon diffusion and impingement of the particles on surfaces of the filter media.

Electrical Precipitation a Cleaning Factor

A certain amount of the cleaning is undoubtedly due to a form of electrical precipitation. We have understood for many years that at low relative humidities a certain proportion of the efficiency of fabric or untreated wool air filters is due to electrostatic precipitation.

We have also been familiar with the well defined magnetic fields sometimes observed on fabric filters. High static charges — rising in intensity to thousands of volts — are sometimes developed on filter media by air friction. Charged and uncharged particles much smaller than could be "screened" out are collected in this manner.

In periods of high relative humidities or in the presence of oily mists, however, the static charge is dissipated and the efficiency of the filter in removing small particulate matter is drastically reduced.

This difficulty has been experienced with certain types of commercial air filters in which an electric charge is impressed on the media.

Studies in this country and abroad have developed filtering media which will generate and retain static charges even at high relative humidities. It is commonly appreciated that wool and resin are especially effective materials for use in producing charges of static electricity by friction.

By carding certain types of resin into wool, a filtering medium is produced which is efficient in removing small dry particles from an air stream, the air being cleaned both by mechanical impingement and by electrostatic precipitation. The resistance to air flow of this construction is relatively low for felt filters and a static electric charge is retained over long periods even at high humidities. The filter may be reconditioned after use by cleaning and recarding the wool.

Billinton has reported (see Journal, Inst. Heat. and Vent. Eng., 15:46, 1947) the operating characteristics of a self charging electrostatic wool filter which was developed in Denmark, as shown in the accompanying table.

Similar methods of treating wool fibers to produce electrostatic filtering properties have been developed in this country and the material is

commercially available in limited supply.

Another type of self charging electrostatic air filter produced in this country utilizes rubber as a filtering medium, the filtering bed is much deeper than in the wool filters and as the dust load is distributed throughout the depth of the filter the resistance to air flow does not build up as fast as with the surface type of air cleaner.

The handling and disposal of dry type filters after they have accumulated their maximum load of radioactive impurities presents a formidable problem. These filters collect and concentrate in a small area the radioactive material collected from the air and soon become too "hot" or highly charged to approach in person. If allowed to collect an excessive load, they may re-emit radioactive particles or gamma rays to the ventilating system. The filters must be removed from the filter chamber, transported and disposed of by a carefully planned system of remote control — an expensive and potentially dangerous procedure. The methods of disposing of radioactive wastes vary at different plants. Usually the material is buried in the ground or, where such a procedure is practical, the material is mixed with cement, stored in oil drums and later dumped 30 miles or so at sea.

Wet Type Air Cleaners Studied

A recently declassified report of the Atomic Energy Commission (Decontamination of Radioactive Waste Air, by R. P. Hammond; U. S. Atomic Energy Commission, Tech. Inf. Div., Oak Ridge, Tenn.) covers a study of wet type air cleaners for removal of very light concentrations of a dry, insoluble radioactive salt.

The investigators considered various types of wet collectors, such as spray towers, capillary air washers, baffle plate scrubbers, fan and dust collector cyclone units, and venturi scrubbers. They feel that constructions of this type would offer certain advantages over unit dry type filters now in rather general use for this work.

Instead of storing up and concentrating radioactive contaminations in a small area, as is the case with the unit type of dry filter, the wet collector discharges contaminations continuously from the system — thus preventing a build-up of radioactivity. The amount of material collected from the air stream in actual mass is very small compared with the liquid wastes which must be handled from the same operations.

The volume of liquid from the wet collector is also a very small addition to the other liquid wastes for which arrangements must be made. Discharges from the washer can be piped directly to the disposal area, eliminating much of the procedure necessary for the disposal of contaminated filter media.

For their tests, the investigators constructed a baffle plate water tower consisting of 42 baffles in series. A later report (Air Decontamination Tests With Baffle Plate Towers, Capillary Washers and Fiber Glass Pads, by R. P. Hammond and J. A. Leary, Los Alamos Scientific Laboratory, Los Alamos, N.M.) outlines the results obtained by adding glass fiber pads to this construction. This report also describes tests on the capillary washer.

With both the water tower and the capillary washer, the investigators report an increase in efficiency when glass pads are included in the system.

A series of three double capillary units in which the air passed through six units in series gave efficiencies of 92. 7 percent against the test aerosol. With one glass pad added to the system the efficiency rose to 99.6 and with two pads, 99.8 percent efficiency was reported. By the addition of heat and the creation of a "fog chamber", still higher efficiencies were obtained.

The problem is radically different from that for which the usual air cleaning system is designed. The air to be handled is usually cleaned before being used by the most efficient air cleaning devices available and the utmost care is taken throughout the plant to prevent the development of dusts which might become radioactive by contacting some of the materials in process. The dust loading in the test installations was extremely light — that is, somewhere in the neighborhood of 4×10^{-6} grains/ft^3. Efficiencies were determined by counting for alpha activity on targets taken in front and in back of the cleaner.

This method would appear to furnish a satisfactory check on the removal of radioactive particles. It has been shown that radioactive material less than a billionth of a grain in weight, much too small to be visible in any optical microscope, can be detected by a Geiger counter, or in the case of alpha particles by a similar technique.

The investigators have brought out in this report a number of features which would recommend the use of a well designed air washer for the removal of airborne radioactive material, provided adequate efficiencies can be assured.

More Efficient With Radioactive Particles

There seems to be some evidence that air washers may be more efficient in eliminating radioactive particles than non-radioactive material. A construction on the order of the capillary air washer has been reported to give satisfactory efficiencies against radioactive particles of 0.5 micron and larger, while against non-radioactive material of the same dimensions, the efficiencies were much less.

In studies made by Sir Ernest Rutherford in 1902, it was pointed out that snow and moisture were very efficient agents in removing certain forms of radioactivity which are normally present in the air.

It is apparent that certain types of electrostatic precipitators are very efficient in removing sub-micron particulate matter from an air stream. It is very difficult, however, to give comparative cleaning efficiencies for different types of air cleaners, owing

[*Concluded on page 90*]

OPERATING CHARACTERISTICS of self charging resin wool filters against atmospheric dust

Filter	Air velocity, fpm	Resistance, inches of water	Photometric efficiency (Initial %)
Resin wool felt 1/8" thick	14	0.3	99.6
Resin wool felt 1/8" thick	14	0.09	95
Resin wool lap 1/2" thick	20	0.08	74
Resin wool lap 4" thick	45	0.10	70
Resin wool lap 4" thick	246	1.27	75
Resin wool felt P	17	0.30	90

District Heating Industry Reviews the Year's Progress

New edition of district heating handbook, all-time membership high are among developments reported at annual meeting of National District Heating Association held in Detroit last month . . . . . Use of summer steam for air conditioning had a prominent place on program

AMERICAN BUSINESS has found that air conditioning is an essential service, and thus every customer of a district heating company is or will be a potential customer for air conditioning, said John A. Gilbreath, Servel, Inc., in a paper on steam possibilities for air conditioning given as part of the report of the air conditioning committee at the 42nd annual meeting of the National District Heating Association, which was held in Detroit last month. The industrial and business advantages of air conditioning are just as important in a war economy as they are in a civilian economy, he stressed.

Air Conditioning With Summer Steam

The amazing growth in the public acceptance of air conditioning affects the economics of the district steam utility business, he pointed out. The district steam utility has a huge investment in boilers, mains, meters, etc., which lie practically idle in the summer. New gross revenue from steam sales in summer therefore becomes, practically, net revenue to the steam utility, Mr. Gilbreath said.

Recent developments in absorption refrigeration machines, which use steam to chill water for air conditioning service, as well as steam turbine driven centrifugal refrigeration compressors, make the use of district steam for summer air conditioning feasible, he said. Absorption machines are available in sizes from 3 to 350 tons of refrigeration capacity and can be used in combination to handle a wide variety of air conditioning requirements. Absorption machines use 16.5 to 18 lb per hr of steam per ton of refrigeration, he stated.

Steam-using dehumidifying equipment also has "tremendous promotional possibilities" for the steam utility.

Absorption Equipment for Apartments Analyzed

The reasons for the selection of steam absorption equipment for air conditioning the Parkway House apartment development, Philadelphia, were outlined by Wirt S. Scott, of the Philadelphia Electric Co., in a second part of the NDHA air conditioning committee's report.

This 13 story structure, which is under construction, will contain 250 apartment units, with stores on the first floor, and requires 512 tons of refrigeration for air conditioning. Advantages of the absorption type of refrigeration for this development include the conservation of equipment space due to location of the refrigeration machines on the roof, reduction in the cost of piping due to penthouse location of refrigeration equipment, and the ability to operate the air conditioning refrigeration in all seasons of the year without establishing a high demand charge—as might be the case, for example, during "in-between" seasons of the year if electric power were used. The principal economies, in his experience, achieved by the use of absorption refrigeration for air conditioning are in the lower cost of condenser water piping due to the roof location of the equipment, and the reduction in electrical substation and wiring investment.

(In describing his analysis of this installation, Mr. Scott mentioned that 488 sq ft per ton of refrigeration could be used as a basis for a quick estimate for an apartment in the Philadelphia area, and 315 sq ft of usable office area per ton for preliminary estimates on the air conditioning of office buildings. It is more accurate to base such estimates on a sq ft rather than a cu ft per ton basis, he stated. The maximum electrical demand for a mechanical system may be approximately and quickly estimated by adding one-third to the tonnage figure, and using the result for the kw required, he mentioned.)

Mr. Scott's analysis of the apartment development was based on 16.5 lb of steam per ton of refrigeration and 1350 hr of use at maximum demand per year, multiplication of the two figures (and, of course, the tonnage) giving the annual steam consumption for air conditioning the building. The steam cost was 74c per 1000 lb, a low summer rate, and electricity cost was about 1c. It was brought out in the subsequent discussion that an increase of 5c or so in the steam cost might have changed the picture insofar as use of steam rather than electricity for air conditioning was concerned. An important factor to be considered in a cost comparison of this kind, and which

is sometimes overlooked or not fully appreciated, is the wiring and substation cost with the mechanical system of refrigeration, Mr. Scott indicated.

E. J. Benesch, of Syska & Hennessy, Inc., could not be present to give his paper on the design of the United Nations headquarters buildings using turbo-compressor refrigeration equipment for air conditioning, so the report of the air conditioning committee concluded with a color movie illustrating some of the UN construction work.

Mechanizing Underground Piping Construction

A feature of the report of the NDHA's distribution committee, of which George K. Saurwein, Negea Service Corp., Cambridge, Mass., is chairman, was a paper by Alex Douglas, superintendent of underground lines, Cleveland Electric Illuminating Co. His remarks were supplemented by an excellent color movie showing the equipment he described in operation.

Quoting from Mr. Douglas:

"Immediately following World War II, like all organizations engaged in the performance of work wherein manpower was the prime unit of production, we in the underground lines department of the Cleveland Electric Illuminating Co. were confronted with the task of counteracting the effects of increasing labor costs and decreasing individual productivity. The increased costs of manual production made it advisable for organizations such as ours, which had previously relied on hand work, to investigate the use of mechanical methods.

"The mechanization of our operations involved (1) The translation of our requirements into specifications for mechanical equipment which was already on the market, or which could be developed; and (2) the procurement of this equipment. To coordinate the performance of these two tasks, our management appointed a committee to initiate and direct a company-wide program of mechanization. A study of our operations showed that the maximum gains could be attained from improvements in the pavement removal operation. This is true because all other operations depend on the speed with which pavement is removed. Thus pavement removal was the first operation tackled by the mechanization committee.

"Representatives of our company and representatives of one of the large manufacturers of air compressors and pneumatic tools worked together in developing our first improvement in the method of removing pavement. A machine was developed which consists of six pneumatic rock drills connected to a single air manifold and mounted on a tractor. A 600 cfm diesel engine-driven air compressor was attached to the tractor and used as the source of compressed air to operate the drills.

"This machine which we call the line drill, is used to drill a line of six holes at a time, 1 ft on centers, through the pavement. The machine is moved forward in steps of about 4 in. and the drilling operation is repeated, thus producing a continuous line of holes.

"Another machine which we call the broacher was developed to cut the web between the holes in the pavement. Upon completion of the paving and broaching operation on both sides of the section of pavement to be removed, we had a large continuous slab of pavement between the slots.

"To solve the problem of removing the slab of pavement, we obtained, on a rental basis, a machine which can perhaps be best described as a mobile combination of interchangeable tools attached to the end of a telescoping boom. This boom can be extended and retracted, raised and lowered, tilted each way from horizontal, and rotated on a horizontal plane by means of power hydraulics. The rotating platform is truck-mounted. This machine was equipped with a special bucket and used to break off, pick up and load slabs of pavement as much as 15 ft long.

"The use of the line drill, broacher, and this machine to replace the air hammer and hand loading for pavement removal resulted in a 45 percent reduction in direct labor costs and a reduction in total costs (including equipment ownership costs) of approximately 25 percent for this operation.

"In our mechanization program, we have found that quite often equipment which is purchased or developed to improve one operation can also be used to effect economies in other operations. This was especially true for the machine described above. In addition to its use in removing pavement, we have found many other

"A MOBILE COMBINATION of interchangeable tools attached to the end of a telescoping boom" perhaps best describes this machine used by Cleveland Electric Illuminating Co. in underground piping construction. Equipped with a special bucket, it is used to break off, pick up and load slabs of pavement as much as 15 ft long

PAVEMENT CUTTER as used in Cleveland for underground piping construction saws 2 in. slots in pavement 18 to 54 in. apart. Saving in direct labor costs of 85 percent and total saving (including equipment costs) of 48 percent have resulted from its use

uses, such as excavating trenches and manholes, driving and pulling sheeting, grading lawns and driveways, and many others.

"Within the limitations of its application for excavation, our excavation costs have been about 50 percent lower compared with hand shovel work and about 15 percent less than with conventional trenching machines.

"Upon completion of development work on the line drill and broacher, studies were begun on methods of improving other operations. Representatives of our company visited equipment shows in various parts of the country to observe and study recent developments in construction and material handling equipment.

"At one of these shows, representatives of the company found a machine called a swing loader which seemed to be the answer to many of our problems. This machine was tried and later purchased. It is a front-end loader with a built-in 105 cfm compressor. The application of the swing loader to backfilling trenches and loading excess dirt on trucks resulted in reduced costs of about 50 percent for these operations. In addition, the swing loader also made it possible to reduce the number of compressors on a job since it could also be used to supply air for pneumatic tools when not in use for other operations.

"Employees were encouraged to submit ideas which might effect economies in our operation. One such idea resulted in the development of a device shaped like an elongated 'S'. The upper end of this device can be hooked over the top of wood sheeting and a pneumatic air hammer can be set in the lower end to drive the sheeting. This device, which is still in the developmental stage, makes it possible to eliminate scaffold construction and to reduce the number of men involved in the driving of sheeting.

"Increased use of mechanical equipment which was already available in the department was also part of the mechanization program. Studies of our operations revealed that our truck-mounted crane could be used more extensively in excavating manholes.

"To improve the methods of lowering transformers, steam pipe lines, expansion joints, valves and other similar equipment, a hydraulically operated crane was purchased. This machine is producing an annual saving of about 19,000 man-hours.

"All of the equipment which has been mentioned so far is equipment which could be used on steam line construction and maintenance. Numerous other pieces of equipment have been purchased or developed to improve our operations.

"Perhaps the pride of our new equipment is the latest development in pavement cutting machinery. The line drill and broacher are not the most silent pieces of equipment which could be used on city streets. In combination with the staccato noise of the pneumatic hammers, the drilling produces a dusty condition. Although the dust was overcome by forcing water into the drill holes, the department was dissatisfied with the problem in public relations which was created by the machine's noise.

"This time representatives of our company presented the problem to a leading manufacturer of cutting apparatus. A year's work resulted in the development of the pavement cutter. This machine is designed to reduce to a minimum any inconvenience resulting from street openings for the installation or repair of underground utility lines. The pavement cutter has two large wheels with tungsten carbide-tipped bits which saw 2 in. slots in pavement 18 to 54 in. apart. The 15 ton machine is mounted on four solid rubber tires and is powered by a 75 hp gasoline engine. It travels from job to job at a speed of 12 mph in direct gear drive. A hydraulic lift feeds the machine at speeds up to 4 fpm while cutting depths as great as 15 in. A 250 gal supply of water is carried to allay dust and to cool the bits.

"The pavement cutter is relatively quiet by comparison with other methods of pavement removal. The use of this machine has resulted in savings in direct labor costs of nearly 85 percent over the air hammer and hand loading method of removing pavement. Total savings, including equipment costs, are estimated at about 48 percent.

"The many improvements in the operation of our department, and the savings which resulted from these improvements have proved to us the value of an active and continuous program of mechanization.

"In all of our work we consider three questions. (1) Will the new equipment or method work? (2) Will the new equipment or method pay? (3) Is the new equipment or method safe?

"The effect of our program in percentage-wise reduction of costs has been excellent. In terms of money, we have and are saving many thousands of dollars."

Accomplishments During the Year

In his annual address, George H. Tuttle, of The Detroit Edison Co.,

retiring NDHA president, pointed out that this was the fifth annual meeting of the association which had been held in Detroit, the most recent one having been in 1937. Now—as then —, he said, the cost of underground steam line construction was a major problem of the industry.

An outstanding accomplishment during the past year was the editing and publishing of the third edition of the NDHA Handbook, a few copies of which were available at the meeting for inspection and a morocco bound copy of which was presented to J. Earl Seiter, Consolidated Gas Electric Light and Power Co. of Baltimore, chairman of the educational committee responsible for the handbook. John F. Collins, Jr., secretary-treasurer of the NDHA, had devoted a major part of his time in recent months as technical editor of the new handbook.

Other noteworthy accomplishments of the past year included a new code on condensate metering, said Mr. Tuttle. Five per cent of the steam (3 million lb) sent out by member companies of the NDHA "just fades away", he said, and is unaccounted for.

In the report of the membership committee, by Frank B. Mahon, Allegheny County (Pittsburgh) Steam Heating Co., it was noted that the NDHA membership is at an all-time high, with 544 members and an increase of 24 percent in number of members during the year.

Foster L. Stephens, also of the Allegheny County Steam Heating Co., noted in his report as chairman of the operating statistics committee an increased tendency of district heating companies to burn fuels other than coal.

Alfred T. Veness Elected President

Alfred T. Veness, Rochester (N.Y.) Gas and Electric Corp., was elected president of the NDHA, taking office at the conclusion of the meeting. Percy A. Hyde, Ohio Edison Co., Akron, was elected first vice president, Charles W. Deeg, Philadelphia Electric Co., was named second vice president, and Thomas P. Brown, Jr., New York Steam Corp., third vice president. The chairman of the nominating committee was David W. Loucks, of the Allegheny County Steam Heating Co.

Registration at the meeting was approximately 250, including guests and ladies, and Leo F. Collins, of The Detroit Edison Co. and a member of HPAC's board of consulting and contributing editors, was general chairman of the annual meeting committee. E. E. Dubry, The Detroit Edison Co., presented greetings at the "get acquainted" luncheon and reviewed some of the history of Detroit, which is marking its 250th birthday this year. Next year's meeting will be held at Skytop, Pa.

Further information on the reports presented at the meeting will appear in a future issue of HPAC.

CIVIL DEFENSE —

[*Concluded from page 86*]

to the various procedures used for determining cleaning efficiencies. Results obtained by the particle count method show no relation to those obtained by discoloration tests or by procedures depending on the weight of material collected by the air cleaner. For this reason, results obtained by different investigators are confusing unless the test method used is borne in mind.

Because of the possibility of power failure, breakage of ionizing wires and similar maintenance problems it is desirable to provide a membrane type of aftercleaner for electrostatic equipment. One of the self charging electrostatic felt or rubber filters would appear to be excellent for this purpose.

From the information developed and declassified by the Atomic Energy Commission, as well as from previous experience with air cleaners, it would appear that certain types of commercial air cleaners now on the market would give satisfactory results, in our so-called "cold war" economy, in eliminating light concentrations of airborne radioactive aerosols from a ventilating system.

Where there is any possibility of occasional contamination of the air by adjacent operations with radioactive materials or where it is decided to provide protection in case an enemy should elect to use radiological weapons other than the atom bomb, it would be entirely practical to install automatic monitors to give warning of the presence of the slightest trace of radioactive contamination.

Aid Defense —

More scrap

means more

steel!

Shock Wave Is First Consideration

For protection against airborne radioactive poisons in atomic warfare, the first requirement for the ventilating system is the ability to withstand the shock wave and incendiary effects of the explosion.

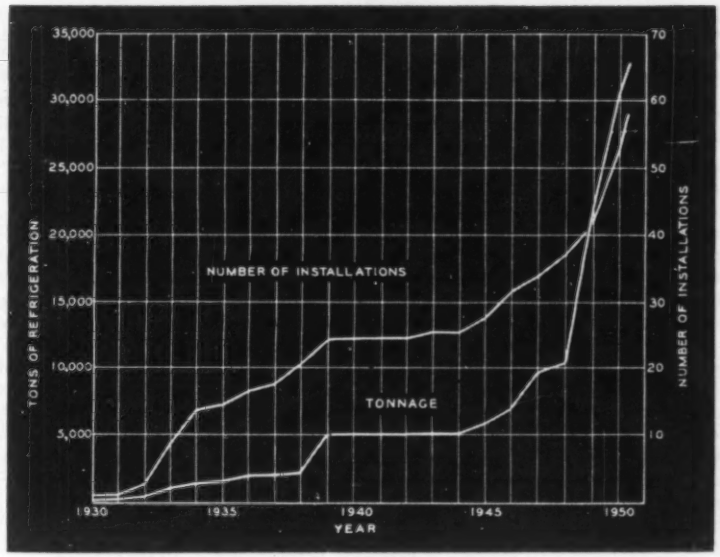
Sufficient information is available to enable the engineer to design or re-design ventilating and air conditioning systems to operate with probable success under such circumstances.

This new field of engineering service demands many types of engineering knowledge and skills. Each situation and each structure requires individual consideration, research and treatment.

AIR POLLUTION PREVENTION ESSENTIAL

PUBLIC SENTIMENT against industrial air pollution has reached the point where the expense involved to prevent such pollution must be considered by the process plant owner as the price that society demands of him for permission to operate his plant, according to A. G. Christie, professor emeritus of mechanical engineering, Johns Hopkins University, at the second process industries conference sponsored by the process industries division and the Baltimore section of the American Society of Mechanical Engineers. If every reasonable measure to abate the discharge of objectionable products into the atmosphere is not taken voluntarily, it will be forced by more restrictive legislation, he declared.

More restrictive local ordinances and increasing publicity are evidence of the mounting awareness of air pollution on the part of the American public, he said. "The contamination of the atmosphere is due to many causes, not all of which are understood by the public," he stated. "There is no pure air in nature. It contains windborne dusts, pollens, odors and gases from natural sources."



GROWTH OF AIR CONDITIONING installations using steam on mains of New York Steam Corp. Rate of growth has been striking since end of World War II

Big Gain in Steam Use for New York Air Conditioning

New York Steam Corp. Promotes Steam Turbine Drives and Absorption Machines for Large Comfort Cooling Systems

ONE OF THE PRIMARY difficulties facing a central station steam system is the lack of load during the summer months. Among the largest district heating companies, the annual system load factor ranges from 22 to 39 percent, with a weighted average less than 30 percent. For comparison, the annual load factor of a typical large electric system runs between 50 and 55 percent.

An answer to this district heating problem is comfort cooling by means of steam. If the demand during the slack summer months can be built up by air conditioning applications, the steam system will obtain improved load factor and better earnings, and its customers will benefit from the low summer rates generally applicable to this type of offpeak load.

In New York City, the New York Steam Corp. has been promoting comfort cooling by steam for a number of years. As may be seen from the accompanying chart, substantial results have been obtained — particularly since the end of World War II. In 1948, a total of 360 tons was added; in the following year, with a number of large installations, a tonnage of 11,205 was contracted for. In 1950, new buildings with a total refrigerating tonnage of 9770 contracted for steam service. This rate of growth has extended into the present calendar year.

It seems a long way back to 1930, when promotion of steam air conditioning began. At that time, the steam jet was for practical purposes the only type of equipment commercially accepted. The next 10 years saw the steam turbine-centrifugal compressor come in general use, and in recent years there has been developed an improved absorption

unit. Today, the engineer is able to select from these basic systems one that will meet almost any conceivable comfort cooling problem.

Steam Turbine Is "Work-Horse"

The steam turbine directly connected to the centrifugal compressor has been the work-horse of steam-using comfort cooling. In the larger tonnage installations, it is still the preferred medium.

The United Nations Secretariat is perhaps the most discussed new building of the day. It is cooled by two identical turbo-compressors with a total rating of about 2300 tons. These and two additional steam units of 950 tons each are located in the basement of the Meeting Halls building. The two smaller turbo-compressors will serve the General Assembly and the Meeting Halls building, both now under construction.

The United Nations designers were fortunate in having a location on the bank of the East river. River water will be used for condensing the refrigerant as well as the steam used to drive the turbines. Without access to river water, the building would have required an additional story to house cooling tower equipment. It is estimated that the intake of river water will average about 14,000 gpm.

While operating experience is not yet available, it is expected that design of the UN installation will result in a number of operating savings. Water temperatures in various parts of the cycle are automatically controlled. Steam is admitted to the turbines at line pressure with the regulator set at minimum line pressure to eliminate fluctuations in the supply.

Turbine driven compressors respond to the load by adjusting automatically to the supply chilled water temperature, and will cut back to as little as 15 percent of rating without attention. Over the likely working range of the turbines, the curve of steam per ton-hour will be fairly flat, so that ease and economy of operation are assured.

The turbines used at the United Nations Secretariat building are expected to have a water rate of 14.55 lb per hp-hr at 125 psi saturated steam and with 26.5 in. of vacuum at the condenser. The smaller systems serving the other two UN units have a calculated water rate of 15.25 lb per hp-hr under the same conditions.

The UN installation was engineered by Syska & Hennessy; Harrison & Abramovitz were the architects.

Absorption Machines Have Many Applications

The majority of the large installations in Manhattan use turbo-compressors, but absorption units have their own applications in this field. Available in tonnages up to 350, absorption units may be connected in parallel to produce the required refrigeration capacity.

The absorption machines lend themselves especially to building conversions, where the original design

REPRESENTATIVE STEAM air conditioning installations connected or in process of being connected to the mains of the New York Steam Corp.

Name	Address	Type of Building	Type of Installation	Capacity in Tons
British Empire Building (Rockefeller Center)	624 Fifth Ave.	Stores & offices	Steam jet	300
French Building (Rockefeller Center)	610 Fifth Ave.	Stores & offices	Steam jet	300
Metropolitan Life Ins. Co.	326 Fourth Ave. & 25 Madison Ave.	Offices	Turbo-compressors	1,625
Tiffany's	2 East 57th St.	Store	Turbo-compressors	400
Best & Co.	641 Fifth Ave.	Store	Turbo-compressors	800
Universal Pictures Bldg.	441 Park Ave.	Offices	Turbo-compressors	1,000
United Nations	405 East 42nd St.	Library	Steam jet	180
United Nations	425 East 42nd St.	Offices & Assembly Hall	Turbo-compressors	4,200
R. H. Macy Co.	105-73 West 34th St.	Store	Turbo-compressors	1,680
Bloomingdale's	59th St. & Lexington Ave.	Store	Turbo-compressors	1,000
Burlington Mills (Empire State Bldg.)	350 Fifth Ave.	Offices	Absorption	150
1407 Broadway Realty Corp.	1393-1407 Broadway	Offices	Turbo-compressors	2,400
100 Park Avenue, Inc.	100-16 Park Ave.	Offices	Turbo-compressors	1,950
Mutual Life Insurance Co. of N. Y.	1730-50 Broadway	Offices	Turbo-compressors	1,500
Port of New York Authority	619-37 Eighth Ave.	Bus Terminal	Turbo-compressors	1,000
Uris Building, Inc.	378-92 Madison Ave.	Offices	Turbo-compressors	2,200
W. P. Chrysler Bldg. Corp.	660-70 Third Ave.	Offices	Turbo-compressors	1,400
Massachusetts Mutual Life Insurance Co.	600 Fifth Ave.	Offices	Absorption	1,100
Dun & Bradstreet, Inc.	93-107 Church St.	Offices	Turbo-compressors	1,000
Lerner Stores Corp.	63-7 5th Ave.	Store	Absorption	350
Sutton-53rd Corp.	431-43 East 53rd St. and 424-40 East 54th St.	Apartment	Turbo-compressor	800
Master Properties, Inc.	183 Madison Ave.	Offices	Absorption	220
Lever House	53rd St. & Park Ave.	Offices	Turbo-compressors	700

lacks space for turbo-compressors. The units can be installed at about any level in the building, and are so light that they often require no strengthening of the floors. Absorption machines have a number of selling points which stem from the unit's basic design but which seem built in expressly for the salesman's use.

Having only one small moving part, a solution pump, they are free from vibration. What operating noise exists can easily be contained in a room of ordinary construction by simple acoustic insulation.

The property of the turbine in maintaining a fairly constant ratio of steam input to tonnage output is more than equalled in the absorption machine. Sustained operation at as low as 20 percent of rating does not appreciably increase the steam usage per ton-hour.

By locating the equipment on higher floors, the rentable space is kept free and available down below. In the case of the building erected at 600 Fifth Ave. by the Massachusetts Mutual Life Insurance Co., now known as the Sinclair building, for example, it was estimated that by locating the absorption units on the roof practically all of two stories of basement were freed for rentable purposes. What with the trend to basement garages, restaurants and shopping arcades, basement floors are assuming increased importance. One building plan calls for four floors of subsurface garages.

A further advantage of locating the cooling equipment on the roof is in the elimination of condenser water piping through the building. Chilled water lines must of course be run regardless of the type or location of the refrigeration equipment.

The Sinclair building lends itself to study as an example of a rooftop installation. The building is typical of many New York structures in that it is an office building of about 5½ million cu ft, 26 stories high. The lower floors cover most of the 25,000 sq ft plot and then there is a sharp setback to a tower which continues to the top.

The entire refrigerating plant, with the exception of the chilled water pumps, will be alongside the cooling towers on the tower roof, 26 stories above the street. The plant consists of four 275 ton absorption machines, each weighing about 11 tons.

At the Sinclair building, the condensate will be cooled to about 110 or 120 F by condensing water and then pumped to the cooling towers for use as make-up water. It is estimated that this partly cooled condensate will supply about two-thirds of the make-up water required, and it has been pointed out that the fact that the condensate is pure distilled water will lengthen the life expectancy of the cooling system. Where the use of cooling water is closely regulated, as in New York City, this byproduct water is of considerable value.

Architects for the Sinclair building are Carson & Lundin; the engineers are Jaros, Baum & Bolles.

Apartment Buildings Being Conditioned

Provision for complete air conditioning has been included in practically all postwar commercial construction in New York and it appears safe to say that within the next few years, assuming an improved international situation, none of the important existing buildings will fail to make similar provision. Installation costs of as much as $1000 per ton do not appear to be a deterrent. But central air conditioning of residential space has until recently been almost non-existent. New construction of apartments has taken place during an acute seller's market, and there have been no hotels built since 1930. Such air conditioning as does exist is largely in the form of room coolers.

There are now signs of a change in this situation, however. Three large new apartments have installed, or are now installing complete central air conditioning. The first of these to be located on New York Steam Corp. mains, the 400 family development under construction by the Paul Tishman Co. at Sutton Pl. South and East 53rd St., will be cooled by turbo-compressor equipment. R. L. Stinard, who engineered the installation, is sufficiently impressed with the reliability and performance of the turbine that he has specified a single 800 ton unit. The experience of other steam corporation customers — dating back as far as 1936 — justifies this confidence in the turbo-compressor.

The architect for this project is Arthur Weiser.

One of the obstacles to the promotion of air conditioning with steam has been the reluctance of some engineers and owners to "pioneer". There is no longer any basis for this frame of mind, considering the backlog of satisfactory experience which has been accumulated. It is difficult to name a prominent consulting engineer in New York City who has not been connected with a steam air conditioning installation.

New York Steam Corp. will continue to promote this kind of load in the belief that it can provide comfort cooling by steam to its customers as effectively as it has supplied them with steam service for heating since 1882.

THEATER UNITS CLASSED AS PERSONAL PROPERTY

UNIT AIR CONDITIONERS without ducts, used as motion picture theater equipment, have been reclassified as "personal property" by the National Production Authority for determination of costs of alteration and construction as required under the amended construction order M-4. As noted in the June HPAC (page 100), such units were previously classified as real property. Centralized air supply and conditioning installations with ducts continue to be classed as real property.

Under M-4, the value of personal property need not be included in determining construction costs, although the cost of installation must be considered. For real property, both equipment and installation cost must be considered.

GAS AIR CONDITIONING AWARD ANNOUNCED

THE AMERICAN GAS Association has announced its fourth annual "progress award" for gas utility companies that have made the most outstanding contributions in 1950-1951 to the advancement of gas summer air conditioning. In addition, individual recognition will be given to members of the winning utilities who had a part in their accomplishments. The awards are sponsored by Servel, Inc., and consist of cash prizes and a trophy.

Entries must be addressed to H. W. Doering, chairman, AGA Gas Summer Air Conditioning Committee, American Gas Association, 420 Lexington Ave., New York 17, before September 15.

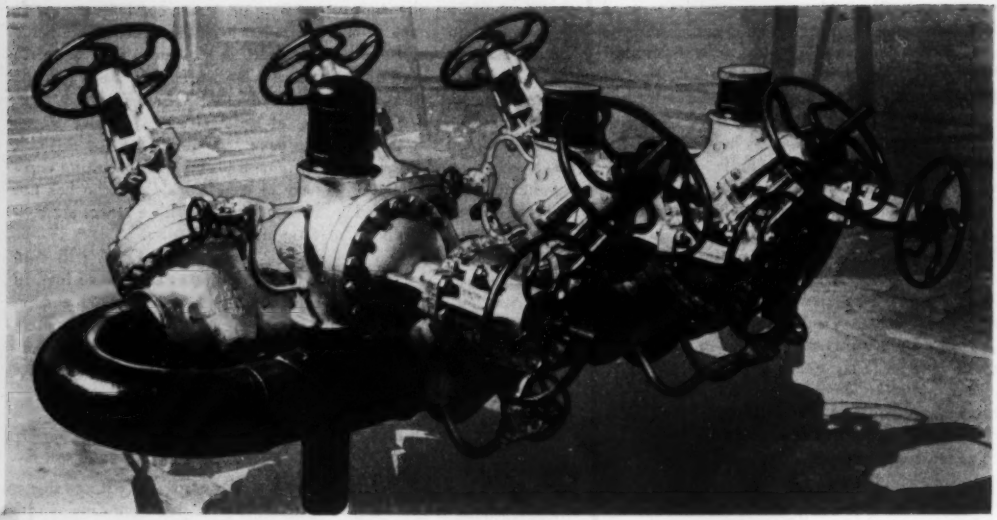


FIG. 1—MAIN STEAM HEADER unit fabrication for service at 435 psi and 750 F. The assembly comprises five 10 in. and three 8 in. 400 lb cast steel welding end gate valves.

Unit Piping Fabrications Save Space, Time, Money

G. W. Hauck, manager of engineering sales, Crane Co., describes two examples of unit fabrications for a power piping system — the main steam header and the boiler feed discharge header. Shop fabrication of assemblies of this kind offers a number of installation advantages, he says, and short headers such as those shown facilitate plant operation by compact grouping of the principal valves

PREFABRICATED HEADERS, particularly for main steam and boiler feed services, when placed in position represent a sizable increment of a completed power piping installation. They often serve as useful starting points from which the principal lines subsequently can be installed to terminal points.

The shop fabrication of such headers in units provides many economies by eliminating difficult problems of field fabrication and assembly, and saving erection time. Completion of the piping system is expedited because these large units have been tested and proved sound before shipment to the job. They can be installed finally and completely, without awaiting final testing of the entire piping system.

The accompanying illustrations show two unusual units recently fabricated for a plant in the middle west. They are fine examples of the marked trend of designers toward short headers which facilitate plant operation through the compact grouping of the principal valves. Fig. 1 shows the main steam header and Fig. 2 the boiler feed discharge header.

The unit fabrication for the main steam header consists essentially of two parallel headers which are connected at one end by a return bend to make a U-shaped loop header with sectionalizing valves. The capped opening is for the connection to a future turbine. The two beveled end openings are for connections to a boiler lead and to a desuperheater,

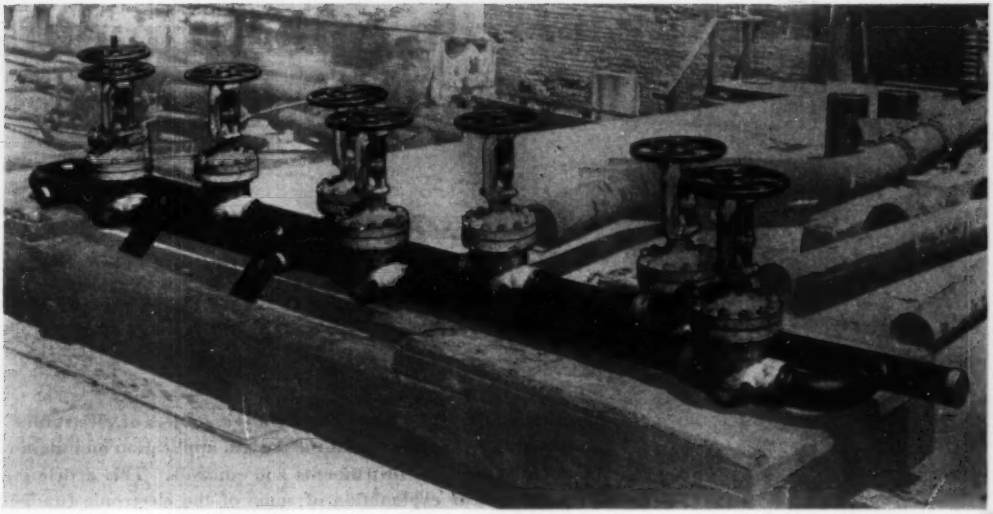


FIG. 2—BOILER FEED PUMP DISCHARGE HEADER fabricated for the same plant. Operating conditions are 500 psi and 225 F. After completion, assembly was tested hydrostatically as a unit, as was header in Fig. 1

respectively. Operating conditions are 435 psi and 750 F.

The assembly comprises five 10 in. and three 8 in. 400 lb cast steel welding end gate valves, plus welding fittings and fabricated piping, all integrated to produce the finished unit fabrication.

The valves have stellite faced seating surfaces and are equipped with built-up welded bypasses in several types, as may be observed in the photograph. The fabricated piping (used to connect the valves into the assembly) consists of A-106 grade B seamless steel pipe and grade B welding fittings. All welded nozzles and drip pockets are of the reinforced type and conform to the requirements of the ASA Code for Pressure Piping. All welds were stress relieved.

The over-all length, center to center, is but 12 ft, 1½ in., and the width is 2 ft, 6 in. center to center. Total weight of the assembly as shown in Fig. 1 is 11,640 pounds.

The boiler feed discharge header shown in Fig. 2 is patterned after the main steam header of Fig. 1 in that two parallel headers are connected at one end by a return bend to produce another U-shaped loop header with sectionalizing valves. The terminal end at the extreme right connects to the existing boiler feed piping system. The two parallel runs are 4 in. and have two 3 in. beveled end welded nozzles for connections to pumps and two 4 in. nozzles for connecting piping to a new boiler.

This assembly comprises eight 4 in. 600 lb cast steel welding end gate valves, A-106 grade B seamless steel pipe and welding fittings. Operating conditions are 500 psi and 225 F.

The over-all length is 15 ft, 2 in. and the width is 12 in. center to center. Total weight of the assembly as shown is 2570 pounds.

After completion, each of these entire assemblies shown was tested hydrostatically as a unit. Thus, their soundness for two vital services was verified in advance of installation in the field.

Unit fabrications such as those described can contribute greatly to the success of power piping projects.

"UNLIMITED HORIZON" IN BUILDING INDUSTRY

THE BUILDING CONSTRUCTION industry offers a stimulating challenge and an unlimited horizon for technically trained young men entering the field, in the opinion of Peter W. Eller, chairman of the board of governors of the Building Trades Employers' Association of New York City.

In recent lectures to the graduating class of the Mechanics Institute, a technical trade school sponsored by the 165 yr old General Society of Mechanics and Tradesmen, and to the faculty and civil engineering class at the Newark College of Engineering, Mr. Eller outlined the history of the construction industry and its employment opportunities.

He said the continued mechanization of building techniques would increase the need for technically trained men to supervise the organization of the job and to direct "all vital steps in the production of a building at a given place at a given time for a particular purpose."

Mr. Eller, a former president of Thompson-Starrett Co., Inc., general contractors, told the Mechanics Institute graduating class that the industry:

"Offers the opportunity for imagination, judgment, science and just plain common sense. There is so much room for accumulated knowledge and new angles in the design of our buildings, in their layout, in their structural safety and in the economies of utilization and cost, that for me there is no horizon."

The construction industry, he said, is second only to agriculture in our national economy and ranks first in employment opportunities. He added, however, that it is not a compact industry such as steel or automobiles, but is composed of approximately 300,000 individual firms with more than 65 percent employing less than 10 men on an average over a year.

Electronic Instruments and Controls

By Kalman Steiner and Wilmer G. Carter

Complete study of the somewhat involved subject of electronics is not necessary to understand the design, application and maintenance of electronic instruments and controls. This article is a brief and clear explanation of some of the electronic fundamentals used in heating, piping and air conditioning work. The authors are with C. Hoffberger Co., and Mr. Steiner is a member of HPAC's board of consulting and contributing editors

IN LESS THAN A dozen years, electronic devices have earned themselves a permanent place in many heating, piping and air conditioning applications, and the science of electronics is a means of accomplishing a number of long-sought objectives in such diverse applications as flame safeguards for automatic firing, smoke detection, temperature regulation and other forms of automatic control. The science of electronics is necessarily involved, but a complete study of it is not necessary to an understanding of the nature and functioning of these useful devices. This article presents a brief review of that much of electronics fundamentals as required to comprehend the design, application and maintenance of some of the more common electronic devices.

The operating engineer is accustomed to thinking of electrical circuits in terms of wires or other conductors. A break in the continuity of the conductor means an interruption of the circuit. Similarly, electronic circuits employ wires and other conductors. But in the vacuum tube the circuit is completed across open space. *This is perhaps the basis of distinguishing electrical from electronic circuits.*

A Vacuum Tube Is a Valve

The beginning of electronics is the vacuum tube, which is essentially a valve — a means of controlling the flow of a stream of electrons. In simplest terms, a vacuum tube comprises an envelope from which air has been evacuated, containing a number of electrodes or elements. The envelope usually consists of a glass or metal bulb. The number and description of the elements within the envelope may vary, but at least two are always present, known respectively as *cathode* and *anode* (or plate). When only these two elements are present, the tube is called a *diode*. When there are three elements the tube is called a *triode;* four, a *tetrode;* and five, a *pentode*.

Actually, the cathode may consist of two parts — but is still considered a single member for a reason that will be apparent from a discussion of the part the cathode plays in tube operation. It is the function of the cathode to emit electrons into the space between itself and the anode. Electrically, the cathode is negative. Whenever the anode is positive, electrons will move toward it from the cathode. Principally, therefore, a cathode should be an emitter of electrons. Hence, it is made of material that yields electrons freely when heated. In some tubes, the heating current flows directly through the cathode, but in others it flows through a separate filament that heats the cathode indirectly. In the latter case, the filament is disregarded in counting the tube elements, since it plays no part in the electronic sequence.

One of the commonest applications of a diode is the rectification of alternating current into direct. It has been mentioned that electrons will flow toward the plate only when it is positive with respect to the cathode. Ordinary 60 cycle alternating current goes through a complete cycle, or change from zero value to a positive maximum to zero, to a negative maximum and back to zero, in 1/60 of a second. Thus, the tube will permit passage of current only in that 1/120 of a second that the anode is positive, but shuts off flow during the negative half cycle. Hence, the output of a diode used for rectifying alternating current would be a pulsating direct current. To smooth out the pulsations, a system of condensers and reactors is hooked up to form a filter, which overcomes to a considerable degree the peaks and valleys in the momentary value of the rectified direct current. In ad-

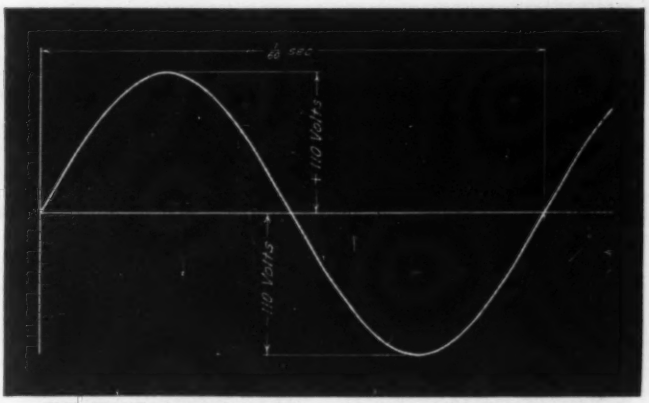
dition, two rectifier tubes, or a single tube with two plates and a common cathode, may be connected in such manner that one anode rectifies one-half of the alternating current wave and the other rectifies the other half, alternately.

Some rectifier tubes, after being evacuated of air, have a small amount of another gas — such as argon, neon or mercury vapor — admitted into the envelope, and are then known as *gas filled*.

A triode contains a third element (called a *grid*) located between the cathode and anode, having the function of controlling the flow of electrons to the plate. By means of a variable negative charge, the intensity of the electron stream can be governed, and even stopped. This is because a negative charge on the grid repels electrons and drives them back toward the cathode, or prevents or retards electron emission by the cathode. The difference in potential between grid and cathode is the *bias;* that value of bias that causes electron flow to cease is the *cutoff point*. Because the grid is placed much closer to the cathode than to the anode, a very slight change in bias can result in a much larger variation in tube output. Hence, a triode often serves as an amplifier, and has the function of picking up minute or faint signals and increasing their intensity.

When still another element, called the *screen*, is interposed between the grid and the anode, the tube becomes a tetrode. Electrically, the screen is positive with respect to the cathode, but at less potential than the plate. Hence it has the effect of stimulating the passage of electrons toward the plate. The screen has other functions, involving reduction of the capacity effect built up between grid and plate.

The added velocity of the electrons due to the action of the screen causes the impact of electrons upon the plate to release other electrons in what has been called *secondary emission*. A fifth tube element, called the *suppressor* and placed close to the plate, by being made negative will drive these electrons back toward the plate and prevent interference with the normal flow of electrons from cathode to plate. The presence of cathode, anode, grid, screen, and suppressor within a tube makes it a pentode.



SINE WAVE characteristic of 60 cycle, 110 volt alternating current. Change from zero value to a positive maximum to zero, to a negative maximum, and back to zero takes place in 1/60 of a second

Each tube element is supported within the tube envelope in such manner as to maintain its correct space relationship to the others. Electrical connections are made by sealing the wires leading from the elements in the glass or other envelope material, and terminating the wires in prongs that fit into the respective sockets of the base receptacle. Sometimes the anode connection is brought out through the top.

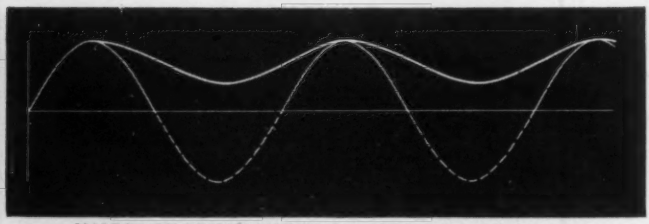
Some tubes contain elements having identical functions, such as the rectifier with two plates so as to rectify both halves of the alternating current wave. Such a tube would be known as a *double diode*, rather than a triode. Similarly, a tube with one cathode, two plates and two grids would be a *double triode* rather than a pentode.

Photoelectric Tube Is Radically Different

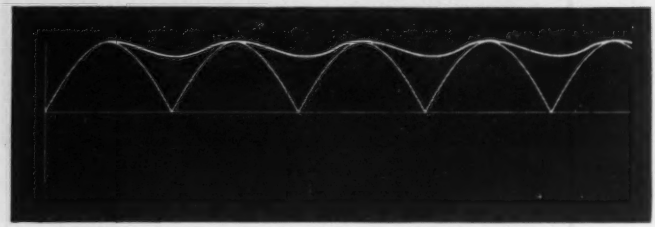
Radically different from the vacuum tube is the *photoelectric tube*, which responds to light intensity and is capable of translating light variation into voltage or current variation. Three types of photoelectric action have been recognized: *photoconductive*, *photoemissive* and *photovoltaic*, meaning (respectively) the property of conducting a current only when light is present, of emitting electrons only when light is present and of generating a current like a battery only when light is present. Only the first two kinds are in general use in photoelectric devices and electronic circuits.

The rate of electron emission or conductance of a phototube varies directly as the intensity of the light falling upon it. Different materials respond to different wave lengths, a fact which is of special importance for safeguarding the flame of an oil burner, since a phototube can be selected that will respond to the short wave length of light from a flame rather than to the long wave length of light from incandescent refractory. In a typical phototube, the anode is a rod at the tube axis, and the cathode is a half cylinder, composed of copper with a silver plating, over which a thin film of light sensitive material is coated.

One of the figures illustrates the elementary circuit of a diode used as a rectifier. Its output would be a pulsating, unidirectional or direct current. Actually, a combination of condensers and reactors would be connected into the output circuit, in any practical application, as a means of damping the pulsations. Another figure portrays a theoretical circuit embodying a rectifier as a source of direct current, connected to a triode and a phototube in such manner that light impulse falling on the phototube would cause it to complete a circuit that would operate a relay such as might be used to control an oil burner. Actually, commercial forms of control panels take on more complicated networks, first because a rigorous sequence must be followed each time a burner is put through an operating cycle, and second because only a single vacuum tube is needed, with several functions combined in a single tube.



HALF-WAVE RECTIFICATION, damped, of an alternating current



FULL WAVE RECTIFICATION, damped, of an alternating current

We can now consider the problems posed in safeguarding an automatic industrial oil burner. First, a group of preliminary conditions must be proved as a prerequisite to attempting a start: adequate draft, safe oil temperature, fuel feed at minimum and absence of false or premature flame indication on either the pilot or the main burner.

Safeguarding an Industrial Oil Burner

The first three steps are not unique to electronic hookups. Some sort of sensitive, balanced tilt plate is housed in such manner that it will swing when adequate draft prevails in the breeching or overfire, and in swinging tilt a mercury tube to establish the starting circuit up to that point. Similarly, a thermostat inserted into the electric fuel oil heater at the boiler front will close to clear the starting circuit if the oil temperature is high enough for a safe start. A switch on the variable flame motor shaft closes only when in minimum fuel feed position.

The clearing for absence of false or premature flame indication is a function of the electronic system, and consists essentially of a single pole, double throw relay that takes the "running" position whenever the gas pilot electrode senses a gas flame or the photocell sees an oil flame. In taking the running position, the relay opens the starting circuit, and the burner cannot start after a shutdown until the safe start relay resumes the starting position. Hence, any flame burning during what should be the burner off period will prevent the burner from starting.

Having proved the preliminary conditions for a safe start, the control system, upon a call for heat, will start the burner fan and oil pump, and ignite the gas flame. The latter has the function of igniting the oil flame. But the main fuel valve will not open until the establishment of the gas flame has been proved. For this purpose, the control system embodies an electrode assembly having a probe rod that reaches into the region where the gas flame normally burns. Failure of the gas flame to be established will prevent the main fuel valve from opening. Furthermore, grounding of the probe rod will either prevent opening of the fuel valve or cause complete shutdown of the burner.

The ignition period persists for sufficient time to assure that the oil flame has become firmly established — a matter of 45 to 90 seconds. Meanwhile, assuming that the oil flame is now burning, the photocell establishes a holding circuit parallel to that of the gas flame electrode, so that when the gas flame is shut off the photocell keeps the running circuit maintained. Of course, should the oil flame not establish itself, for any reason, at the end of the ignition period the burner will shut down.

In some systems, the burner will make a second attempt to start by repeating the entire starting cycle. In others, after one unsuccessful attempt at starting, the control system locks out. Should oil flame establish in the normal manner, the variable fire motor positions itself for the prevailing load and a relay shunts out the low-fire start lockout. At the same time, if a mechanical or electrical overfire draft controller is in use, the controller is now permitted to take over; up to this point, the damper has been held wide open for the starting cycle.

Other components of the control circuit not yet mentioned are:

Starting switches for the mechanical draft fans, if any; usually an interlock keeps the burner from starting until these pull in.

Vapor pressure switch on the gas line, to lock out the oil solenoid if adequate gas pressure for a safe pilot is lacking.

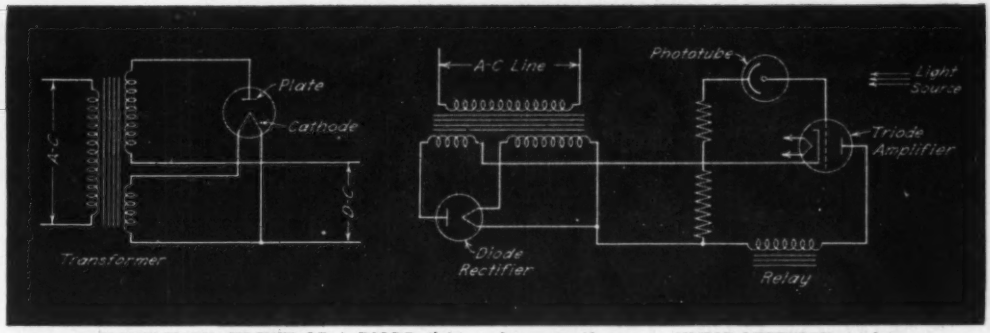
Fan pressure switch on the primary fan housing, to lock out the oil solenoid if this fan fails to develop adequate pressure.

Lockout switch on shaft of damper motor, keeping starting circuit open until damper assumes wide open position prior to a start.

Low water cutout.

One or more of any of these safeguards may be present, depending upon the system design and layout. And, of course, there must be some type of operating controller (such as a pressurestat or a thermostat) governing burner operation in accordance with steam demand. The latter will cause normal stopping and starting. In between, while the burner is running, the variable fire controller will cause the fuel feed and the air supply to vary in unison with variations in demand intensity. Upon a normal shutdown, the mechanical or electrical type draft controller will drive the uptake damper closed, preventing cooling air from circulating through the boiler setting.

The electronic flame safeguard has brought to oil burner operation a degree of safety that precludes almost any conceivable malfunction. Modern electronic systems respond instantly, and avoid feeding fuel under unsafe conditions. Of course, some latitude must be allowed the oil flame for an occasional flicker. Most commercial systems of electronic control have an inertia period of three or four seconds, purposely provided to avoid needless shutdown



ELEMENTARY CIRCUIT OF A DIODE *(left)* used as a rectifier . . . . SIMPLE NETWORK *(right)* combining diode and triode to operate a flame relay through a phototube. This is a hypothetical network for explanatory purposes only, not typical of commercial practice.

because of momentary flame flicker.

An electronic burner control system proves the establishment of the gas pilot flame by probing it with an electrode. Hence the gas flame itself completes the electronic circuit.

Gas Flame Completes Electronic Circuit

A gas flame contains free ions that render it conductive. By the same token, the circuit must be completed to ground, which implies that the flame itself needs grounding. A bunsen burner flame does not touch the tip or pipe from which the gas supply issues, because of the small cone of unburned gas at the base of the flame. Hence the pilot burner must incorporate a design that causes grounding of the flame, by causing it to pass through a metallic tube or perforated plate or sweep over a metallic surface that makes contact with ground.

One system of electronic flame safeguard causes a current rectification to occur within the gas flame. This depends upon the flame conducting more current in one direction than the other. Two electrodes touch the flame, of which one is the ground connection. The second electrode is the flame probe rod. The ground electrode must have an area at least four times greater than the probe rod. The system then passes a rectified current from the probe to ground. This circuit connects to the grid of the first stage in a duo-triode, and in this manner governs the bias of that stage of amplification.

Both the flame electrode and the photocell mounting must provide for quick and easy cleaning. Conditions prevailing in the firebox where heavy oil is burned sooner or later cause deposition of soot. To prevent this soot from reaching the photocell, one or more guard lenses block passage of smoke upward through the photocell housing. These lenses, and the electrode mounting of the probe rod, should be regularly inspected by the operating staff, and cleaned whenever necessary.

LISTS WARTIME USES FOR AIR CONDITIONING

A PARTIAL LISTING of uses for air conditioning and refrigeration equipment is given in a new booklet on products and facilities for meeting the defense and military requirements of the U.S., issued by the Air Conditioning Dept. of General Electric Co. The list follows:

FOOD

Storage and preservation refrigeration equipment.

Ice-cream making equipment.

Self-contained refrigerating equipment for kitchens.

Cargo refrigeration.

MEDICAL

Storage of medicines.

Shipment of blood plasma and whole blood.

Storage of blood plasma and whole blood.

Temperature control for oxygen tents.

Temperature and humidity control for operating rooms.

WAR MATERIALS

Storage under controlled temperature and humidity.

Temperature and humidity control for blending, mixing, pressing, storage of explosives.

Refrigeration for chemical storage.

WATER

Cooling of water for military bases, ships, air fields, etc.

ICE

Ice-making equipment.

INDUSTRIAL PROCESSING

Control of temperature, humidity, air cleanliness for ordnance manufacture.

Temperature and humidity control for storage of tools and metals.

Maintenance testing refrigeration facilities.

Low temperature rooms for testing.

Temperature control for reclaiming solvents.

ENGINEERING

Refrigeration for use in engineering laboratories.

Humidity control for drafting rooms.

PHOTOGRAPHY

Controlled temperature, humidity, air cleanliness in photographic work.

AIR FORCES

Fur storage refrigeration.

Humidity control for drying parachutes in storage.

Link trainer buildings.

Aviation control towers.

DOCUMENTS

Temperature and humidity control for storage of valuable documents.

STRATEGIC BUILDINGS

Air conditioning for underground and other strategic enclosed structures.

Activated Carbon Equipment Recovers Vaporized Solvent

A NEW SOLVENT recovery plant for The Garlock Packing Co., Palmyra, N. Y., using activated carbon as the adsorbent, collects about 1000 lb per hr of gasoline from the air and delivers it ready for re-use. The gasoline is vaporized during the manufacture of asbestos sheet packing. In addition to the profitable recovery of the gasoline, working conditions in the plant are improved, the hazards of handling gasoline vapors are reduced and discharge of large volumes of solvent-laden air into the surrounding area is avoided.

In its acceptance test, the installation showed a recovery plant efficiency of 99.24 percent; that is, the air exhausted from the plant contained only 0.76 of 1 percent of the solvent in the air delivered to the recovery plant. Operating records for a 10 month period since the plant started show an overall monthly efficiency of 95.9 percent, indicating both high collection and high recovery efficiency. This efficiency has been obtained in spite of the fact that the plant has been operating under widely varying load conditions some of the time and at a low concentration of solvent vapor handled.

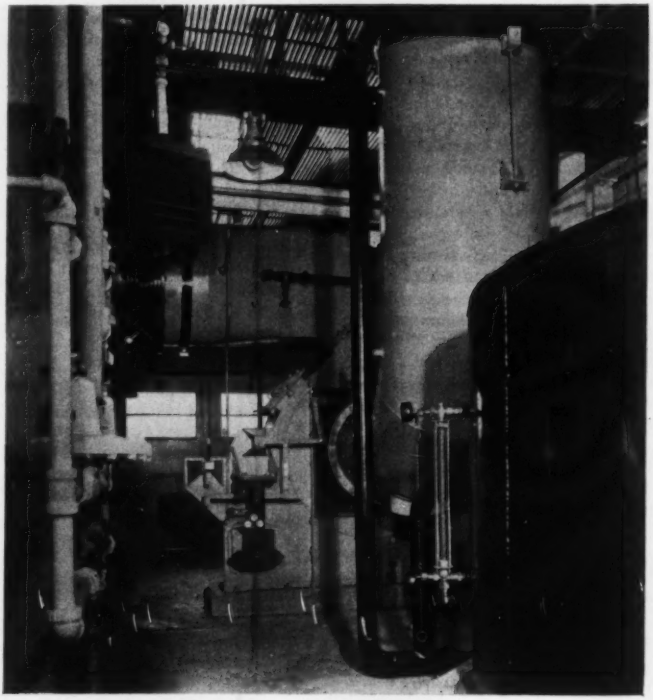
Special Hoods and Ducts

Since the gasoline is highly volatile and highly flammable, it was necessary to give careful consideration to the handling of this solvent vapor at all points in the recovery cycle and especially at any points where the vapor might conceivably escape. Prerequisite to high overall recovery is the efficient collection of the vapor from the sheeters. Special hoods and ducts were designed to meet the conditions, and to satisfy the requirement of adequate ventilation of the sheeters at all times so that the concentration of solvent in the exhaust air could be kept within a safe limit.

Each sheeter is equipped with a tight-fitting hood under which the asbestos packing sheet is formed. Air is drawn from the top and bottom of the sheeters to maintain a negative pressure in the hoods. Since air from the room must replace the vapor laden air drawn from the sheeters, this negative pressure keeps any stray vapors confined to the sheeter and ultimately passes them into the collection ducts. The vapor laden air from all sheeter hoods is collected in a 36 in. duct which delivers it to the recovery building.

The total air volume handled by the blower is automatically controlled and develops a suction of about 1 in. of water at the recovery unit air inlet. This air volume is held con-

AT GARLOCK PACKING CO., 95 percent of the vaporized gasoline used in the manufacturing process is recovered for re-use and to improve plant and surrounding conditions. Vapor laden air is collected from the sheeters and passes through this blower to adsorbers. Black pipe returns recovered gasoline to decanter at right



stant and is sufficient to insure adequate ventilation when all the sheeters are in operation. The large air-handling capacity permits wide latitude in manufacturing operations without risking hazardous concentrations of solvent in the exhaust air.

Safety Features Stressed

To make certain that the concentration remains within safe limits at all times, a combustible gas analyzer maintains a continuous 24 hr record of the concentration of solvent vapor in the main duct leading to the recovery building. Concentration is recorded as percentage of the lower explosive limit. If for any reason it exceeds one-half of the lower explosive limit, warning alarms are sounded both in the sheeter room and in the recovery building.

Operation of the entire recovery cycle — from the controlled flow of air which collects the solvent vapor from the sheeters to the storage of recovered solvent ready for re-use — is fully automatic with the exception of starting up and shutting down. The instrument and control interlocks are in one central panel on the lower floor of the recovery building, with a duplicate set of warning devices in the sheeter room. From this one location, the operator is able to observe and control, by hand if desired, the entire system.

The Recovery Plant

The filter, cooler, adsorbers, condenser, decanter and control panel are in a ventilated, fireproof building just outside the sheeter building. Here, the vapor laden air is passed through the beds of activated carbon.

These beds are composed of small, hard pellets of a special type of activated carbon made expressly for solvent recovery purposes. The pellets are mechanically strong, provide low resistance to air flow through the thick beds and have high resistance to breakage or "dusting", which assures long service life. A cubic inch of these pellets (7.89 grams) has an active surface area of 132,000 sq ft — larger than two football fields.

The vapor laden air is first passed through a renewable, glass fiber filter. In preliminary considerations of using carbon beds, there was some doubt whether the asbestos fibers, flowers of sulfur, talc dust and other materials carried in the air from the sheeters would contaminate the bed. Tests indicated filtration of the air would be relatively simple and would protect the carbon bed and cooling coils. After passing through a finned tube cooling and tempering unit, the filtered, vapor laden air is ready for its passage through the carbon beds contained in three adsorber vessels.

The air enters the top of the adsorbers at one end and the exhaust air issues from the other end to the atmosphere. The vapor laden air stream is passed to each adsorber until the carbon bed is fully charged with solvent. When the carbon bed is saturated — in ordinary operations, this takes about 60 min — the intake air is automatically switched to another adsorber. Then low pressure steam is sent through the saturated carbon bed to drive out the adsorbed solvent and the steam and vapor mixture goes to condensing and separation equipment.

The operating cycle of the three adsorbers is such that two adsorbers are being saturated while the third is being steamed. While there are always two adsorbers receiving vapor laden air, the service periods are automatically adjusted so that when one is fully charged the other is only half charged and the third is cleaned and waiting to be charged.

The air exhausted from each adsorber passes through duct work up through the roof and is free of solvent vapor. This satisfies one of the conditions imposed upon the recovery system — to make the plant a good neighbor to the surrounding area by avoiding situations that could develop from the discharge of large volumes of solvent vapor into the air.

The steam and vapor mixture from the adsorbers goes to a condenser on the mezzanine floor where the mixture is cooled and condensed, and then flows by gravity to a continuous decanter on the main floor. Since water and gasoline are not miscible, the mixture is separated into two layers in the decanter. Recovered gasoline from the top of the decanter is pumped to the storage tanks to be used again without further processing. Here, then, is the answer to the main problem — conserving used solvent from the manufacturing process at a fraction of the cost of buying new solvent. [Photo courtesy Carbide and Carbons Chemical Co., Div. of Union Carbide and Carbon Corp.]

PLANNED MAINTENANCE IS EFFICIENT

"Whenever maintenance work is done in accordance with a prearranged plan, whenever the equipment is taken out of service for maintenance work, the men and materials ready, and instructions and other facilities available, the work is prosecuted rapidly and effectively. In cases when the unit must undergo overhauling or repair at an unexpected moment, when the need was not anticipated, facilities, materials and drawings not provided, and the best fitted men not available, the job usually is not completed and the cost is excessive.

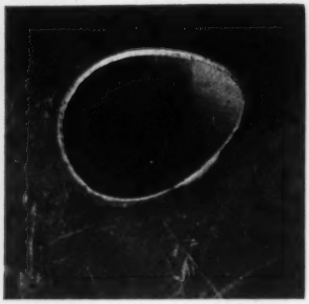
"The value of order is nowhere more evident than in plant upkeep and repair. We make each shift responsible for definite areas and equipment. The operator in that area on another shift will promptly spotlight a condition of equipment neglect if this causes himself extra servicing. I'm glad to give extra credit to my chief power engineer for the condition of our plants. His belief is the theory 'it does not matter what you are doing, if you are working in dirt and disorder your costs are higher than they should be.' If your chief or plant foremen have that philosophy, then your maintenance is in good hands.

"I want to leave with you one last thought regarding the upkeep phase of preventive maintenance. W. F. Ryan, Engineering Manager of Stone & Webster Engineering Corp., with a wealth of experience in both the design and operation of power plants, once said, 'Why waste time comparing what you did last month with what you did a year ago? Find out what your equipment is capable of doing and compare today's performance with that.'

"Aim your sights at upkeep, and major repairs will rarely cause you sleepless nights."—F. L. BRADLEY, Forstmann Woolen Co., at recent Plant Maintenance Conference.

BEVELING OPERATION on 36 in. diameter pipe, with wall thickness of ¾ in.

MANUALLY CUTTING hole for 14 in. outlet on 36 in. OD pipe, ¾ in. wall



FINISHED MANUAL CUT after slag has been removed but before any other finishing operation

Using Oxyacetylene Processes for FABRICATING PIPING

By E. P. Auler
Superintendent of Pipe Fabrication
Taylor Forge & Pipe Works

WITHOUT THE AID of the fabrication methods provided by the various oxyacetylene processes, the manufacture of pipe and the assembly of pipe and fittings into an integral system for conveying liquids and gases in the industrial world's piping and processing installations would not be possible under present conditions of high temperature—high pressure demands.

Gas transmission lines carry pressures as high as 1000 psi in pipe as large as 34 in. diameter. Steam power plants use piping systems at 1500 psi and 1050 F. Oil refining equipment, with miles of piping, operates at even higher pressures and temperatures, and also at the other extreme with temperatures as low as —325 F.

Cutting, Gouging and Heating

In applying the oxyacetelene processes to the manufacture of pipe and to pipe fabrication, let us consider three basic uses:

1) The oxyacetylene cutting torch.

2) The oxyacetylene gouging torch.

3) The oxyacetylene flame of a heating torch.

Since a majority of pipe fabrication is performed on ferrous materials, the use of the oxyacetylene cutting torch provides a convenient and readily portable means for the cutting and shaping of steel at a low cost. Essentially, the cutting of ferrous materials by the oxygen cutting process merely involves the direction of a jet of pure oxygen into an area that has been previously heated to the ignition or kindling temperature, about 1600 F, and as the iron is oxidized, slowly and uniformly moving the jet along the line to be cut. If the cutting is to be continuous, however, it is necessary to supply heat to the metal just ahead of the oxygen stream. This required heat is called "preheat".

Oxyacetylene gouging is a rapid and economical method of forming U-shaped grooves by removing surface or edge metal. In pipe fabrication the gouging operations can be classified into the three following groups:

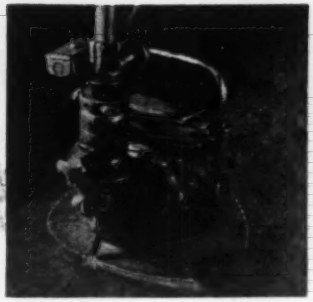
1) Progressive gouging of the underside of electric arc welds.

2) Spot gouging of temporary tack welds and the removal of defective weld metal.

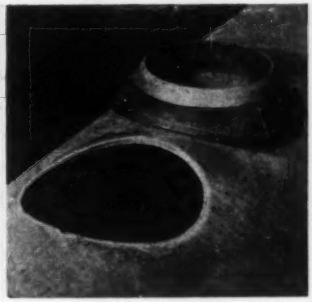
3) The forming of a welding groove suitable for high quality electric arc welds prior to any welding operation.

The gouging process employs the design of a special nozzle to deliver a relatively large volume of oxygen at low jet velocity. This jet, coupled with proper preheat flame distribution, will cut a smooth, accurately defined groove in steel.

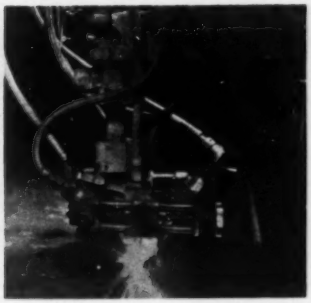
As a means of heating, the combustion of approximately equal volumes of oxygen and acetylene produces a flame far hotter than that of any other known gas flame. The temperature of the oxyacetylene flame is estimated to be about 6000 F. Thus it is a convenient source of localized heat for a wide variety of operations in pipe fabrication, such as heating for forming and bending,



MACHINE CUTTING hole for 14 in. outlet on 36 in. OD pipe, ¾ in. wall, with tip at an angle



MACHINE BEVEL CUT, with slag cleaned, ready to assemble outlet forging



BEVELING PLATE EDGE in preparation for automatic welding of longitudinal seam of 24 in. pipe

for straightening, for preheating and for post heating of a welding operation.

Source, Distribution of Oxygen and Acetylene

The importance of an adequate source and distribution system of oxygen and acetylene gases cannot be over emphasized. When initially setting up equipment or expanding existing equipment, future requirements must be considered for overall plant economy. In some cases the initial investment is quite high and good planning is necessary to realize maximum return on the investment.

There are three basic methods available to supply and distribute gases and they can be used in various combinations to give best overall economy. The first and simplest unit consists of a large cylinder of oxygen and a large cylinder of acetylene, both with regulators, mounted on a cylinder truck or buggy for mobility and ease of handling. To this can be attached most types of manual oxyacetylene equipment and the entire unit transported to the work site. A group of these portable buggies are adequate for a small shop or field operations at a low initial cost. Almost all shops, regardless of size, will use some of these units to supplement other methods of supplying gases.

However, when higher rates of gas flow are required, such as a continuous machine cutting operation, this scheme is not adequate and an arrangement of cylinders called manifolding should be employed. There are two such systems; first, portable manifolding with the unit at the work site, and secondly, stationary manifolding with the manifold supplying a piping system. When the cylinders are manifolded, one group is used as a supply while the other group is being replaced. A continuous gas flow is assured in this way.

Another possible variation is the manifolding of oxygen cylinders and the generation of acetylene gas from calcium carbide in acetylene generators. These generators are available in sizes capable of producing from 12 to 6000 cfh of acetylene gas. They are also available in both stationary or portable units.

This second method provides a continuous gas flow and with the exception of the piping system mentioned is very economical in initial cost. This system might be said to be best suited for the average fabricating plant.

The third and most adequate source and distribution of gases involves a piping distribution system throughout the entire fabricating plant.

The source of oxygen is either long high pressure tubes permanently mounted at the fabricating plant or on truck trailers, or a liquid oxygen storage holder on the fabricator's property. Both of the above are permanently connected to the piping distribution system through a suitable regulator.

Acetylene is supplied to the pipe system by means of relatively large acetylene generators with sufficient standby equipment to allow for recharging of spent generators.

The piping system must be properly designed to handle and distribute the gases without undue pressure drop and to deliver adequate volume required at the various work sites throughout the fabricating shop. Both acetylene and oxygen lines are usually parallel.

Connections to the piping system at the point of use are made by suitably designed equipment. The oxygen line is generally fitted with a filter, a shutoff valve, hydraulic back pressure valve, relief valve, a vent pipe to the outdoors and/or a regulator. The hydraulic back pressure valve is a protective device which prevents flashback or backfires from entering the main piping system. These are strongly recommended for all acetylene piping systems.

This last method involves a large initial cost but results in economical gas consumption and is suitable for the larger fabricating shops. Since the initial cost is high, adequate capacity must be designed for to take care of future expansion in the shop facilities.

General Applications of Oxyacetylene Processes

Oxyacetylene Cutting Operations

In considering the general applications of the oxyacetylene processes in pipe fabrication, let us first investi-

Manufacture of pipe and its assembly with fittings into an integral system for industrial piping installations would not be possible without the aid of the fabricating methods provided by the various oxyacetylene processes, the author told the International Acetylene Association at its recent meeting in Montreal. He describes these processes here, their practical piping applications

PREPARING WELDING GROOVE by manual gouging on 4-6 percent Cr Mo material

PREHEATING WELDING GROOVE on 4-6 percent Cr Mo material to 600-900 F with large heating torch

STRAIGHTENING END of main run with heating torch after outlet had been welded in place

gate the preparation of material for fabricating. Probably the most common use is the preparation of pipe ends for welding. In this application it is highly desirable to machine cut the ends. A torch is suitably mounted on a stand and the work is revolved at a uniform rate. With the torch set at the proper angle, the pipe end can thus be cut to produce a smooth welding bevel suitable for any code welding with a minimum of cleaning after cutting. A variation of this is a device which clamps to the pipe and is so designed that the torch revolves around the pipe at a uniform rate. This alternate is most often used on small diameter pipe.

Another important use of both manual and machine cutting torches is the preparation of outlets on main line piping. With manual cutting the outline must be center punched to provide the fabricator a mark which he can easily follow. The finished cut will require some grinding to prepare the section for welding. This method is most often used where there are few outlets and the set-up time for machine cutting would not warrant its use.

In the machine torch cutting technique, it is possible to set the torch at the proper angle to prepare the welding groove. A minimum of cleaning is necessary and the outlet can be fitted to the hole without too much fit-up since the hole is a true circle cut to the proper diameter.

In header work, where a number of outlets are fabricated on a given length of pipe, machine cutting has definite advantages. Equipment has been developed and is in use in fabricating shops which can accurately cut the holes in the main run and also cut the nozzle pipe sections to fit the main run contour. Basically, these machines operate by rotating the pipe while a cam or gear drive, interconnected with the pipe rotation, drives the torch—thus giving the desired motion to the torch to cut either the hole or the nozzle contour. These machines are generally limited to a maximum of 24 in. diameter. They can produce square or bevel cuts for straight, curved or angle work on almost any intersection required in pipe fabrication work. They are an excellent example of the versatility of the oxyacetylene cutting process.

In the manufacture of large diameter pipe, it is necessary to prepare the edges of the plate for automatic welding. We advocate the double butt weld and as a result require a double bevel with a land. This operation can be economically performed with oxyacetylene equipment.

The equipment is so designed that all three required cuts are made simultaneously and the resultant edge preparation is ready for automatic welding with only a slag chipping operation. In this process the use of nozzle blocks and premixed gases for preheat again illustrate the versatility of the oxyacetylene cutting process. In our particular set-up, both welding edges of the plate are cut and the ends trimmed at the same time—thus completing the plate preparation in one operation. A total of eight cutting nozzles are in use at one time under the control of an operator and a helper during this process.

Gouging Operations

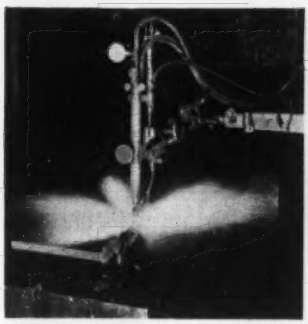
The use of gouging equipment has been accepted by the fabricating shops as another tool to provide better pipe fabrication. At present, the majority of gouging operations are performed manually although we have used this equipment as a machine gouging operation in a few cases with a great deal of success. In a typical manual operation—forming a welding groove on the underside of a weld, cutting the groove down to the sound metal of the inside weld—it is interesting to note that the material gouged was 4-6 percent Cr, Mo and no difficulty was encountered.

The importance of this process in such an operation, as well as in removing defects in welds, is the fact that the operator has full control of the depth of the groove. At the same time he can see when he has reached the sound metal because of the difference in color while the area is molten.

In the fabrication of large diameter piping, a majority of the joints are manually torch cut because they are of the job shop variety and do not lend themselves to the more costly machine cutting set-ups. We have found that a straight cutting operation followed by tacking and then a gouging operation produces a welding bevel most suitable for code welding. The operator follows the square butt joint with the gouging torch, forming a groove to the desired depth for the pipe thickness. This groove is then welded and the underside again gouged to sound metal as previously explained.

Uses of the Heating Torch

One of the principal uses of the heating torch is the preheating of materials prior to cutting and welding. With the constant increase in operating pressures and temperatures, alloy steels have been intro-



TORCH CUTTING 1 in. type 347 stainless plate, an important application of the process

duced to provide pipe structures which will have the necessary physical and metallurgical properties. While some of the low alloy steels in thinner sections can be welded the same as mild steel, heavier sections, restrained joints and certain of the alloys require preheating prior to any cutting or welding operations. The 1951 edition of the Code for Pressure Piping (ASA B31.1-1951) lists requirements for preheating carbon and carbon-molybdenum steels. However, most fabricators have, through experience, determined their requirements for alloy steels as used in fabricated pipe structures.

When the preheat temperature range is from 100 to 400 F, the heating torch is played along the welding joint in a manner so as to heat uniformly the area without too great a temperature variation. Excessive heating or too rapid heating are to be avoided. This operation is almost always done manually.

If the preheat temperatures range from 400 to 900 F, it is often necessary to measure accurately the temperature prior to and during any welding or cutting operation. This can be done with surface pyrometers or special waxes manufactured to melt at a given temperature. The heating torch is then used as often as is necessary during the operation to bring the temperature to the required point. As an operator gains experience he is able to judge temperatures quite accurately by the amount of heat radiated from the weldment. In field applications the heating torch serves very well as an accurate, economical means of preheating. More and more do field fabricators appreciate the heating torch as a means of providing preheat.

A certain amount of distortion occurs in the welding of fabricated piping. This is due to the fact that the structures are relatively thin and thus are not restrained. Although supports and struts are applied to prevent distortion, it is often necessary to perform a straightening operation. Because of the close tolerances of fabricated piping this can best be done with a heating torch. The torch is used to heat rapidly a small band to a plastic temperature. Since the surrounding area is cold, the plastic metal upsets slightly. As the entire section cools, this upset area "pulls"—causing a change in the shape of the section. Generally, several small bands are better than a few large ones. In this manner, for example, main run pipe ends can be rounded up when a header has been welded near the end.

The third important use of the torch is in the heating of sections for forming operations. With the oxyacetylene heating torch, areas of about 6 in. diameter can be heated to approximately 1700-1800 F and the area deformed to fit the required contour by a hand forming operation.

Special Applications in Pipe Fabricating

There are several special applications of the oxyacetylene process which are used in pipe fabricating and although it is beyond the scope here to study them comprehensively, they should be mentioned.

The high chromium and chromium-nickel alloys can be successfully torch cut by use of special equipment and a powder or fluxing material to remove the oxides of the alloying elements which prevent the oxygen stream from reaching the iron and allowing the cutting to proceed. The cut thus made must be ground before any further operations are performed on the piece. This method is applicable to any thickness and we have successfully cut 12 in. billets.

Another special application is stack cutting. This method offers a means of cutting a number of plates simultaneously with a single torch or with multiple torches by stacking the plates and securely clamping them to form a thickness of 3 to 4 in. It is used when identical shapes must be cut from plate in large quantities.

Although not a special application, the cutting of material less than 3/16 in. thickness requires techniques which are entirely different from those previously described. Basically, clean square cuts can be made at relatively high speeds if a leading angle is applied to the torch nozzle and proper tips are used with accurate control of the cutting oxygen pressure and the size and type of preheat flame.

Another unusual application of the oxyacetylene heating torch is the low temperature stress relieving of welds. Two multiflame torches are moved along on either side of the weld to be stress relieved, followed by a spray of coolant water. By moving the assembly at a speed relative to the thickness this application of heating and cooling in effect plastically deforms the weld—thus mechanically stress relieving the weld area.

Adaptable to Shop and Field Conditions

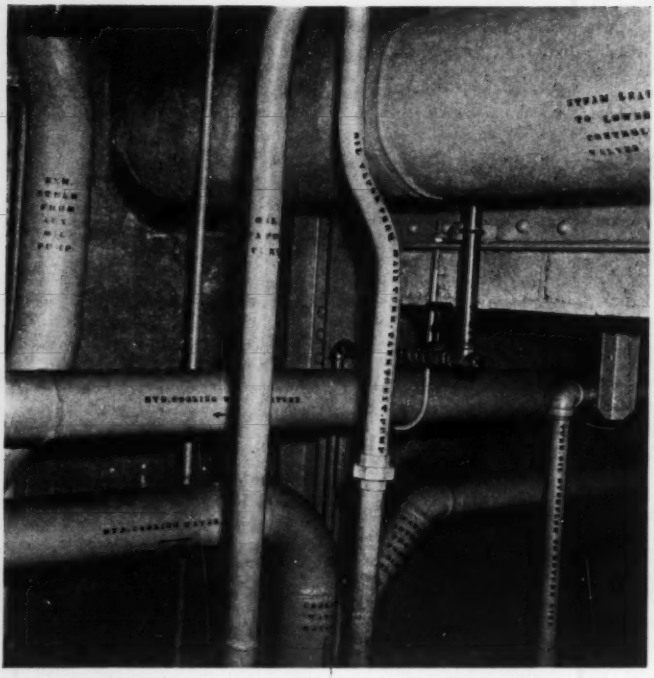
The type of work that can be performed, the number of combinations of equipment possible, the ease of control, the quality of the product, the relatively low initial cost, and, in general, the overall versatility of the various oxyacetylene processes give the fabricator—large or small—a tool which is adaptable to any conditions in his shop or out in the field.

However, this equipment must be used with proper engineering control and the operators must have a good working knowledge of the equipment in order that the greatest value be derived from the processes. Since the mixture of oxygen and acetylene is explosive, rigid safety rules must be adhered to and all required safety precautions taken. Poor quality work is generally the fault of misused equipment or lack of operating know-how—not of the processes themselves.

NAVY USING NEW CALORIMETER

AN ENTIRELY NEW type of calorimeter — a device which measures heat given off by the human body—was demonstrated recently at the Naval Medical Research Institute, Bethesda, Md.

Differing from other calorimeters, the machine continuously measures and records the total amount as well as the individual fractions of heat lost in different ways by a living body. A feature is its quick response to changes in heat output.



PIPING IS PAINTED to match the surrounding structure or equipment, the lines being identified by stenciled labeling with directional arrows showing flow

Power Piping Identification

Boston Edison Uses Stencil Labels

THE BOSTON EDISON CO. has used for some years the scheme of identifying pipe lines illustrated in the accompanying pictures. The pipes are all painted the same color, to match the surrounding structure or equipment, and the lines are identified by stenciled labeling with arrows.

A great deal of information can be conveyed by such labels, and the labels can be placed on the machines and equipment where they are most useful. Where the covering has been damaged by maintenance work, the labels can be replaced easily, and there is no question of matching colors or finding odd colors for a short repair job. Furthermore, the labels mean the same thing to every employee.

It is believed that correct and complete labeling of piping has contributed to proper, speedy and intelligent operation.

The illustrations shown are from the Mystic Station installation, comprising three 50,000 kw units which take steam at 1200 lb and 900 F.

DATA *sheet*

Proper Spacing of Hangers To Support Insulated Piping

Sloane C. Martin, Manager, Low Temperature Insulation Dept., Armstrong Cork Co., Explains Use of Charts Which Simplify Spacing of Hangers for Cork Insulated Lines

UNTIL RECENTLY, there have been two ways of determining the spacing of pipe hangers for cork insulated lines. One was to make an accurate calculation, taking into consideration the weight of the line and its contents, the deflection of the pipe and the compressibility of cork. The second was to make a good guess and hope for the best.

Both methods left something to be desired. It takes a skilled engineer to do the calculations required for the first; and the second can be dangerous, for unless hangers are properly distributed, the weight of the line will compress the cork and cause the finish to crack and open up.

When this happens, maintenance costs rise sharply and the service life of the insulation job is decreased. Moisture from the surrounding air will be forced into any break or opening in the finish and will work

FIG. 1—CORRECT SPACING of pipe hangers for insulated lines that are filled with liquid weighing 90 lb per cu ft and supported by a 10 in. long shield

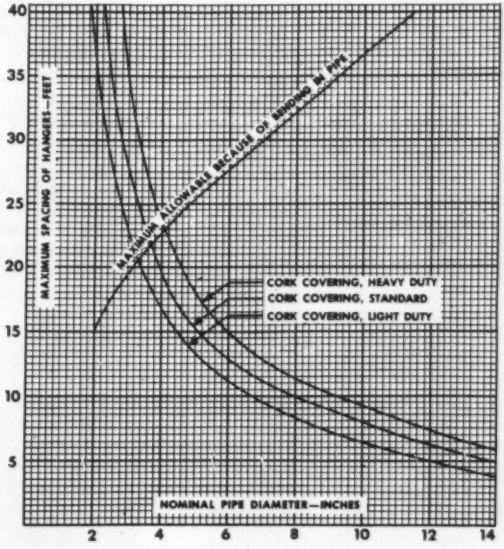
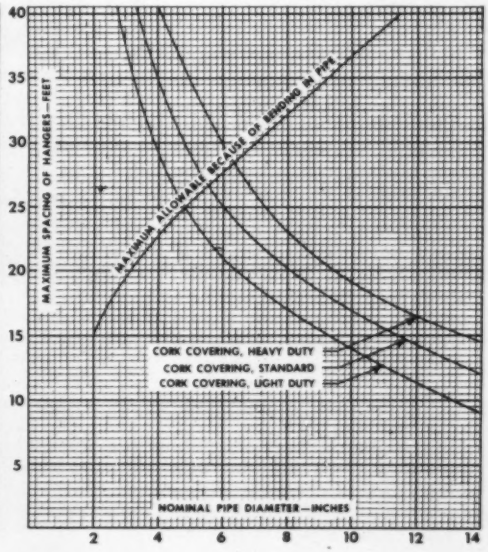


FIG. 2—PIPE HANGER SPACING for insulated lines that carry little or no weight and supported by a 10 in. long shield



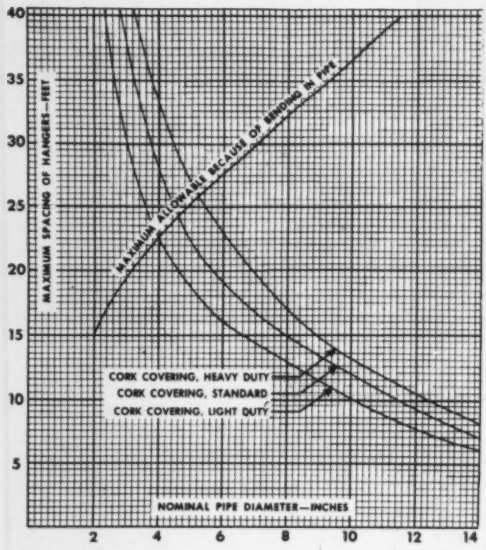

MAXIMUM SPACING OF HANGERS—FEET
MAXIMUM ALLOWABLE BECAUSE OF BENDING IN PIPE
CORK COVERING, HEAVY DUTY
CORK COVERING, STANDARD
CORK COVERING, LIGHT DUTY
NOMINAL PIPE DIAMETER—INCHES

FIG. 3—SPACING OF hangers for insulated lines that are filled with liquid weighing 30 lb per cu ft and supported by a 10 in. long shield

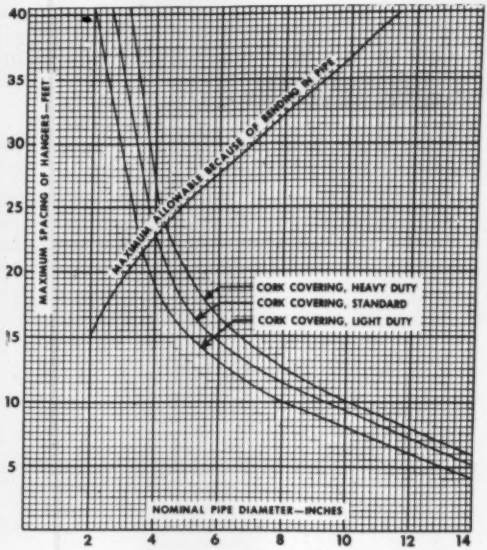

MAXIMUM SPACING OF HANGERS—FEET
MAXIMUM ALLOWABLE BECAUSE OF BENDING IN PIPE
CORK COVERING, HEAVY DUTY
CORK COVERING, STANDARD
CORK COVERING, LIGHT DUTY
NOMINAL PIPE DIAMETER—INCHES

FIG. 4—CORRECT HANGER spacing for insulated lines that are filled with liquid weighing 65 lb per cu ft and supported by a 10 in. long shield

its way into the insulation. Moisture is a good conductor of heat, so efficiency drops. If the lines are cold enough, the moisture will turn to frost. In time, the formation of ice will break up the insulation, causing even more efficiency loss and eventually requiring replacement of the covering.

Simple Planning Pays Out

By using the charts shown here, the damaging consequences of improperly spaced hangers can be avoided. Here's how to use them. For example, let's assume that a portion of a 6 in. line is carrying a liquid weighing 90 lb per cu ft. Shields are 10 in. long, are made of 16 ga sheet iron and enclose half the circumference of the covering. Due to the temperature of the liquid in the lines, standard thick cork covering is to be applied.

First, select the chart (Fig. 1) developed for liquids weighing 90 lb per cu ft, which is applicable to these circumstances. Now, follow a line from the 6 in. pipe diameter at the bottom of the chart to a point where it intersects the standard thick cork covering curve. Then extend the line to the left side of the chart. This figure is the recommended maximum spacing of hangers. It indicates that hangers should be 12½ ft apart.

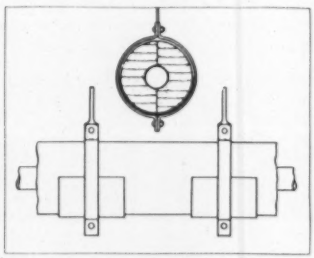


FIG. 5—IF HANGERS AREN'T properly distributed, weight of the line will compress the insulation — which will increase maintenance costs and decrease service life

While this chart, as well as the others, has been developed for the weights of four common liquids, it is easily applied to any others that might be encountered by interpolation between the two graphs that most nearly apply.

The proper spacing for supporting hangers on insulated lines is governed by the weight carried in the line and the pipe size to be covered. This should be taken into consideration during the very first stages of planning the piping layout.

Sam Lewis's Page

. . . . . pertinent comment on practical problems

INFORMAL COMMENT on heating, piping and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, and a member of HPAC's board of consulting and contributing editors. He reports this month some more of the lessons learned from his wide experience.

EXPERIENCE IS THE BEST OF TEACHERS

PERHAPS SOME OF the readers of this "Page" have the impression that the only heating, ventilating and air conditioning installations I have anything to do with have something wrong about them which needs correction. This is not entirely the case, although a consulting engineer does spend a large part of his time on improving existing systems. My principal reason for devoting a good deal of attention in these paragraphs to the modernization and alteration of installations already in use is that I feel experience is the best teacher. The why's and wherefore's of past troubles encountered and corrected are valuable lessons to be remembered on future projects.

A big hotel has its engines and generators in a rather shallow sub-basement, and heat losses from the steam pipes and the machines brought about an unacceptable temperature. Someone attempted to correct this by installing a potent air supply fan with ducts to deliver air from outdoors, through small perforations in the bottom of an air introduction chamber over the engines.

The scheme was a failure, for the entering air from outdoors rarely arrived at the point of need without having acquired too much heat. At times when it was cool enough to absorb the undesired heat, it also caused fog and was uncomfortable for the engineers.

When the scheme was reversed so as to withdraw the hot air directly above the engines, with allowance for entry of air from the adjacent rooms, there was great improvement in the conditions.

There is a husky refrigerating system in this same building, and water for condensing the refrigerant is pumped from the nearby river by means of a turbine pump on a vertical shaft, with the electric motor in an enclosure far above the water line. The water level in the rather small river is alleged to be constant, since it is backwater above a power dam. The top pump bowl was established 5 ft below normal water level.

It was not long before complaint was made of burned out pump bearings. The contractor replaced the bearings. Then the new bearings failed. Eventually it was disclosed that occasionally, during summer especially, the water level was lowered to meet the demands by the various industries to such an extent as to expose the bearings in this badly designed and poorly erected pump.

The top bowl just as well could have been set three times the original 5 ft below the anticipated water level.

I was called back recently to inspect a large hospital heating system that I had designed 30 years ago. The plant was up-to-date at the time of installation and with penurious appropriations for maintenance, has survived well enough so that sufficient goodwill remained for me to be called back.

The outstanding observation was my failure in the original design to provide adequate guides and harnesses for the expansion joints in the high pressure steam mains in the long tunnels. The old slip joints have not failed and do not leak, but flange unions near some of them have leaked, due to imperfect alignment and due to inadequate guides and anchors.

In order to condense the exhaust steam from the steam turbines used to operate the standby boiler feed pumps, I installed the large domestic water heaters in the boiler house, one for 140 deg and one for 180 deg, and pumped the hot water through long tunnel mains to several buildings.

We are now replacing the turbines with electric motors. We will heat the domestic water in the various buildings to 140 deg with high pressure steam, using relatively small outlying transfer heaters. There will be steam heated boosters to bring the water temperature up to 180 deg for the laundry and kitchens. This procedure will save heat loss and will reduce other troubles with the long hot water mains in the tunnels.

We will now install many thermometer wells for insertion of indicating and recording temperature instruments throughout the plant.

The original combustion controls and instruments have been fairly well maintained. A modern deaerating feedwater heater is to replace the old heater, which — like its contemporaries — possessed well-arranged facilities for adding air to the water and thus encouraging rapid corrosion of connected piping.

The inspection of this old hospital plant accentuates the oft-repeated commandment to install a duplicate of every essential mechanical contrivance in a hospital.

There have been numerous occasions when a second or alternate steam main in the tunnels would have been of great advantage, as when installing additional equipment, making emergency repairs or connecting to new buildings.

The hot water flow and return mains in the tunnels, now obsolete due to the changes we are making, will be retained for such emergency steam use, and they point the way toward consideration in future hospitals and similar plants of duplicate mains or their equivalent.

QUESTION of the Month

RADIANT HEATING AND WOOD FLOORS

I READ WITH interest the article on the effect of radiant heating on hardwood floors, by Paul S. Park, Jr., in the Question of the Month columns of the January 1951 issue of HPAC.

I am employed by the Department of Works and Housing, which is the constructional authority of the federal government of the Commonwealth of Australia, and have had occasion to design radiant heating systems using both subfloor (air space) coils with hardwood floors and embedded coils in concrete floors with both concrete and parquetry surfaces.

A heating system recently designed in this office for a two story block of university residential flats employed hot water floor coils to give "background" heating, the remainder of the heat losses being made up by hot water radiators. The floor construction consisted of a structural concrete slab upon which 2 in. of insulating foam concrete was poured between the 4 in. x 2 in. floor joists. Pipe coils of ½ in. black iron pipe were of the continuous type and were laid on top of the foam concrete in the air space under the floor. The flooring was of 1 in. quarter sawn mountain ash (eucalyptus regnans) with a specified equilibrium moisture content of 10 percent.

The system was designed to provide room temperatures of 55 F in bedrooms and bathrooms with an outside design temperature of 25 F, while study and living rooms carried 65 F with part of the heat losses made up by radiators.

The maximum permissible floor surface temperature of 70 F (limited by characteristics of timbers available and the use of rooms) would prevent the full heat losses being met by the floor coils alone in the rooms heated to 65 F and called for water at an inlet temperature of 130 F. The calculated floor heat emission under these conditions was only approximately 10 Btu per hr per sq ft.

I would be interested to know the floor surface temperatures at which outputs of 40 to 60 Btu per hr per sq ft were obtained, and what is regarded as permissible floor temperatures from the point of view of use.

Any information on practical methods of balancing pipe circuits in these systems would also be appreciated. —L. C. W.

USING CONVECTORS, RADIATORS ON SAME JOB

WITH REFERENCE TO the question from "C.H.B.", published in the February issue, about the trouble he has been having in heating a hospital which has convector type radiation in one wing and cast iron radiators in the rest of the building—except for the surgical suite—it would appear that the whole job is unbalanced and that, (a) the convectors are undersized in relation to the heat loss; (b) the supply piping to the convectors is undersized, causing too great a pressure drop and preventing sufficient steam reaching the convectors; or (c) the cast iron radiators were originally too large for the job.

It is obvious that the cast iron radiators will retain heat longer than the convectors.

The operation of a single thermostat control cannot be said to be good practice.

Assuming the convectors to be on a separate supply circuit, it is suggested that a thermostat should be placed within the area served by the convectors, say the surgical or delivery rooms (provided the convectors are not likely to be shut off) and set to control a valve on the main supply to the convector circuit. The existing thermostat within the area served by the cast iron radiators should be set to control a valve on the main supply to the cast iron radiators, and the boiler itself controlled by a pressurestat.

By installing two separate controls, the convectors could operate with full steam supply while the cast iron radiators were throttled, and this would reduce the difference in ratings.

An alternative suggestion, which although more costly would insure more satisfactory results, is to fit a key control valve on the main supply to the cast iron radiators, and set it to balance the steam supply against the supply to the convectors, and to fit thermostatic valves to each of the cast iron radiators and convectors. This would enable each individual radiator and convector to operate to suit the particular requirement of the area served by it. The boiler would be controlled by a pressurestat.

If the convectors and radiators are served by the same supply line, the steam supply to the cast iron radiators could be throttled by fitting orifice disks, and control of the radiators and convectors effected by individual thermostatic valves.

Mixing convectors and radiators on any job, whether steam or hot water, can cause a lot of trouble unless special care is taken in the design and installation.—T.E.deV.

HOW CAN I SOLVE THIS HEAT FLOW PROBLEM?

You are invited to answer the following question from a reader of HPAC. Please address your reply to the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

"I am working on a heat transfer problem in which the heat flow is not constant. A steel test tank with walls 1½ in. thick is to be cooled off after each test. The temperature may be approximately 125 F and is to be lowered to around 70 F in preparation for the next test. The cooling off process is to be done with air, and the problem is: How long will it take?

"In other words, the initial temperatures of both the tank and the cooling air are constantly changing. It seems to me I have seen such problems solved by the use of graphs, and I would appreciate references to such data."—J.B.

Heating, Piping & Air Conditioning

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

JOURNAL *SECTION*

The Control of Air Streams from a Long Slot †

By Alfred Koestel* and Chia-Yung Young, Cleveland, Ohio**

This paper is the result of research sponsored by THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS in cooperation with Case Institute of Technology, Cleveland, Ohio

SUMMARY—This paper presents a method for obtaining uniform air discharge along the entire length of a long slot in the side of a supply duct. Theoretical flow equations are developed and verified by experiment. A practical means of application is suggested to engineers who may be seeking a method of air diffusion that uses long, narrow air streams having high induction characteristics.

A RESEARCH paper on the flow of isothermal air through end supplied slots was published in 1948 in the ASHVE JOURNAL.[1] This paper is a continuance of the subject with special emphasis on the theoretical flow equations derived for outlets of this type.

The basic outlet dealt with herein, is a long slot supplied with air from a tapered duct. Mathematical analysis of the desired air flow was the key to the duct shape. The purpose of the design was to eliminate static regain and thereby produce uniform discharge velocities along the entire length of the slot. This feature would prevent lengthwise stream contraction[1] caused by the non-uniformity of air discharge obtained from a slot in the side of a constant cross-sectional duct. It would also facilitate the design and construction of guide vanes for the purpose of obtaining a stream discharge perpendicular to the axis of the slot. It is believed that the basic device tested in this investigation may be the criterion of good slotted outlet design from the standpoint of air distribution.

Theoretical Analysis

Let the following symbols represent the quantities involved, and Fig. 1 the diagram to which the analysis is applied:

X = distance along duct axis to point in question, feet.
V_x = duct axial velocity at distance X, feet per second.
V_s = slot outlet velocity, feet per second.
h_x = duct static head at the distance X, feet.
h_t = duct total head, feet.
h_v = duct velocity head, feet.
θ = emanating air stream angle from slot, degrees.
A_s = slot area, square feet.
A_d = duct cross-sectional area at upstream end, square feet.
A_x = duct cross-sectional area at X, square feet.
L = slot length, feet.
C_d = coefficient of discharge of slotted orifice.
Q = air quantity, cubic feet per second.
Q_t = total air quantity supplied at duct entrance, cubic feet per second.
S = slot width, feet.

Assuming an ideal fluid, the velocity and static pressure are uniform across the duct cross-section and the total head at any point, X, is constant. Bernoulli's theorem, therefore, states that:

$$\frac{V_x^2}{2g} + h_x = \text{constant} = \frac{V_s^2}{2g} \qquad (1)$$

The quantity of flow through a differential length of slot is:

$$dQ = S\,dX\,C_d\sqrt{2gh_x} \qquad (2)$$

where,

$$S\,dX = dA_x$$

Since the fluid is assumed incompressible, the volume of air entering the supply duct minus the volume discharged from the slot along X must be equal to the quantity flowing within the duct at X. The continuity equation is, therefore:

†Portions of this paper form part of two theses submitted by the authors to Case Institute of Technology. See References 2 and 3.

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**Graduate Assistant in Mechanical Engineering, Case Institute of Technology.

[1]Exponent numerals refer to References.

Presented at the Semi-Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Portland, Ore., July 1951.

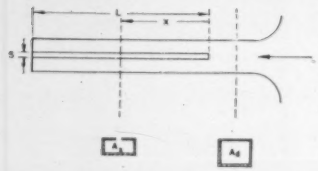

Fig. 1—Long slot with air supply from one end

$$Q_t - \int_0^x dQ = A_x V_x \qquad (3)$$

The foregoing three fundamental equations can be applied to any flow condition in which the air stream approach within a duct is parallel to the outlet. These equations have been successfully applied to ducts of uniform cross-section in which static regain produces a variable flow throughout the slotted orifice. Due to limitation on the extent of the present subject, this topic will be dealt with in a later paper.

The angular direction of the discharged air stream with respect to the slot axis, θ, is related to a vectorial sum of two velocities as shown in Fig. 2. If there is a velocity V_x in the X direction, and a velocity perpendicular to the slot face due to the conversion of the duct static pressure through the outlet, the resultant will be the slot discharge velocity, V_s. This relationship can be expressed as,

$$\tan\theta = \sqrt{2gh_x}/V_x$$

or, $V_s^2 = 2gh_x + V_x^2$ for the right triangle of Fig. 2, which is also the Bernoulli equation. (Equation 1).

In order that the discharge angle θ be uniform along the slot, the duct axial velocity V_x must remain constant with respect to X. Therefore, let the duct cross-sectional area A_x be a variable and V_x a constant in Equation 3. Differentiating the equation,

$$-dQ = V_x dA_x$$

(since Q_t is a constant, dQ_t becomes zero) and substituting for dQ in Equation 2:

$$-V_x dA_x = S\,dX\,C_d\sqrt{2gh_x}$$

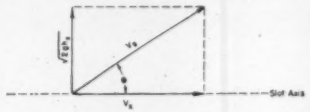

Fig. 2—Velocity vector diagram

Fig. 4—Uniform air flow from a slot supplied by a tapered duct

and

$$\frac{-V_x dA_x}{\sqrt{2gh_x}} = S\,dX\,C_d$$

If V_x is a constant, according to Equation 1 h_x must also be a constant. Substituting the vectorial relationship

$$-\cot\theta = -V_x/\sqrt{2gh_x}$$

into the foregoing equation, we have,

$$-\cot\theta\,dA_x = S\,dX\,C_d$$

and integrating between limits,

$$-\cot\theta \int_{A_x=A_d}^{A_x=A_s} dA_x = S\,C_d \int_{x=0}^{x=L} dX$$

$$-\cot\theta\,[A_x - A_d] = S\,C_d\,X$$

or

$$A_x = [-S\,C_d \tan\theta]X + A_d \qquad (4)$$

which is a straight line equation in the form $y = mx + b$ where m is the slope ($m = -S\,C_d \tan\theta$) and b the y-intercept ($b = A_d$), as shown in Fig. 3. This equation indicates that the supply duct cross-sectional area, A_x, must be linearly decreased under the slot in order to eliminate static regain and to maintain a constant direction of air flow (see Fig. 4).

In Equation 4, when $A_x = 0$, X will be equal to L, the length of the slot. Therefore:

$$-S\,L\,C_d \tan\theta + A_d = 0$$

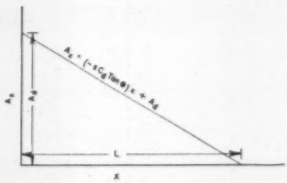

Fig. 3—Relationship between duct size and slot length

and SL = slot area, A_s.
Therefore:

$$\cot\theta = \frac{A_s C_d}{A_d} \qquad (5)$$

The curve of Equation 5 is shown in Fig. 5. The ratio of the velocity head to the total head in the duct may be found by appropriate substitutions. This parameter can be applied in selecting the proper supply fan characteristics for this type of outlet.

Substituting the vectorial velocity relationship into Equation 5,

$$\sqrt{\frac{h_x/h_t}{1 - h_x/h_t}} = \frac{A_s C_d}{A_d} \qquad (6)$$

The curve of Equation 6 is shown in Fig. 6.

Comparison with Test

In order to verify Equations 5 and 6 a 10-ft sharp-edged slot in the side of a tapered supply duct 8.06 × 8.06 inches square at the upstream end was constructed. The width of the slot was adjustable so that the area ratio, $A_s C_d/A_d$ could be varied. A coefficient of discharge for the sharp-edged slot was assumed to be 0.61. The maximum slot width investigated was 3.773 in., ($A_s C_d/A_d = 4.25$), and the minimum width was 0.25 in. ($A_s C_d/A_d = 0.282$).

Pressure, flow, and air discharge angle measurements were made as described in the first paper[1]. Air supply to the test duct was from a large plenum chamber through a rounded entrance nozzle. The air quantity was measured by calibrated orifices and corrected for system leakage. Sidewall static taps were made to *ASME* code specifications, and the pressures were read on calibrated in-

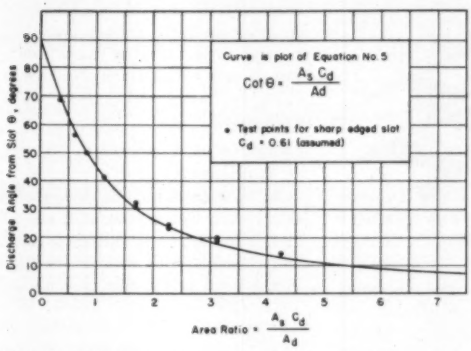
Discharge Angle from Slot θ, degrees
Curve is plot of Equation No. 5
Cot θ = As Cd / Ad
• Test points for sharp edged slot Cd = 0.61 (assumed)
Area Ratio = As Cd / Ad

Fig. 5—Relationship between discharge angles along the slot and area ratio

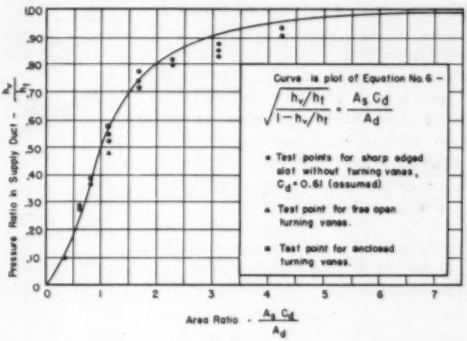
Pressure Ratio in Supply Duct = Ps/Pt
Curve is plot of Equation No. 6 — √(hv/ht) / √(1 − hv/ht) = As Cd / Ad
• Test points for sharp edged slot without turning vanes, Cd = 0.61 (assumed)
▲ Test point for free open turning vanes.
■ Test point for enclosed turning vanes.
Area Ratio = As Cd / Ad

Fig. 6—Relationship between duct pressure ratio and area ratio

clined gages to 0.002 in. of water. All tests were run under isothermal conditions with air volumes ranging from 140 to 1350 cfm. The entire experimental investigation covered a period from 1947 to 1949.

The theoretical curve of Equation 6, (see Fig. 6), which indicates the relationship between the pressure distribution in the duct and the area ratio, shows good agreement with the test points. Each point represents the average pressure ratio obtained for three or four rates of flow. The slight deviation of the data from the curve between area ratios of 2.26 and 4.25 is due primarily to the difficulty of measuring the extremely low duct static pressure for the volume of air discharged in the higher area ratios (large slot area).

Fig. 5 shows the relationship between the constant discharge angles along the slot length and the area ratio. The final direction of the discharge air stream within the space with respect to the slot axis will be the same as the air flow angle θ. The angles measured by a null-type double impact tube air protractor*[1,2,3] show a better agreement with the theoretical curve at the higher area ratios than the pressure ratio curve of Fig. 6. This is due to the fact that the flow angles indicated by the air protractor are a direct measurement of the relationship between the static and velocity pressures. On the other hand, the ratio of the velocity head to the total head involves an orifice flow reading and a static pressure reading at the duct inlet, both of which are subject to errors in reading.

*An indicating thread read on a protractor scale and actuated by the slot air flow was used as a check on this instrument.

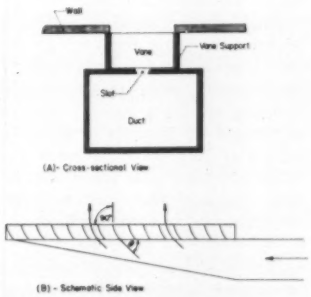

Fig. 7—(A) Installation of enclosed vanes on the slot. (B) Application of turning vanes to slot

Application of Turning Vanes

If it is desired to obtain an air discharge perpendicular to the duct axis, turning vanes or deflectors should be applied. The tapered duct design is best suited for turning vanes due to the fact that the discharge angles remain constant. This feature would make the use of turning vanes along the outside surface of the slotted orifice more practical from the standpoint of design and construction. This would not be possible with a constant cross-sectional duct supplying a slot since each vane would have to be designed to meet the condition of flow at a particular point along the slot which is, of course, a variable due to static regain.

The amount of turning required of a vane would depend on the discharge angle. Deflecting vanes should be located on the outside surface of the slot since the direction of the emanating air stream is determined after the duct static head is converted into velocity through the slotted orifice.

Fig. 7 shows an installation tested for a constant discharge angle of 42 deg. One design factor of prime importance is the ratio of vane depth to vane spacing. According to THE HEATING, VENTILATING, AIR CONDITIONING GUIDE, vanes should have a depth of one to two times the spacing. If the ratio is less than one, effective control of the discharging air stream cannot be obtained. Little improvement is realized by increasing the ratio beyond two. Based on this, turning vanes were tested for ratios of one and two. The vane depth was 3 in. with a curvature designed for a discharge angle of 42 deg. A smoke pattern showed that a vane ratio of one corrected the discharging air stream from 42 deg to approximately 80 deg to the axis of the duct. A ratio of two turned the stream very close to 90 deg.

For appearance the vanes should be enclosed or *boxed in* as shown in Fig. 7 so that they will not protrude out into the occupied space. The effect of free open and enclosed vanes on pressure ratio (h_v/h_t) is shown in Fig. 6. Any change in the coeffi-

cient of discharge from the assumed value of 0.61 due to the vane installation, will deviate the experimental points from the theoretical curve. As a result the actual area ratio will not be the same as the one determined from the physical dimensions of the slot and duct, and from the coefficient of discharge for a free open, sharp-edged slot.

A turning vane, if designed correctly, should have the shape of an air foil so that separation of the deflected air stream from the vane surface does not take place. This, no doubt, would be impractical and uneconomical in actual air distribution installations. Vanes of single thickness are much more easily fabricated than vanes of variable thickness as in an air foil. In order for a guide vane of single thickness and a given height to be efficient, the curvature should be as flat as possible without any abrupt turns. This can be done if a circular arc is used which is tangent to the discharge angle at one end and tangent to a line perpendicular to the slot axis at the other end. The radius of the arc would then be determined by the vane height and the discharge angle. This is illustrated in Fig. 7.

Velocity traverses were taken of the air stream leaving the vanes. It was found that the magnitude of the velocities was at a maximum near the face of each vane and at a minimum immediately behind the vane. In the case of the wider spacing (1:1 ratio) the variation in velocities along the slot could easily be detected by passing a hand over the discharge. For the narrower spacing (2:1 ratio) the velocity variation could hardly be perceived except by pitot tube measurement.

Practical Application

Standardization of vane design can be devised in order to reduce costs of fabrication and installation. This could readily be done by selecting two or three practical discharge angles to be used in all types of slotted outlets. From the equation.

$$\text{Cot } \theta = A_s C_d / A_d$$

various slot lengths, widths, and supply duct sizes can then be chosen for the given discharge angles. Sections of bracketed guide vanes already preset for the selected discharge angles could then be installed along the face of the slotted outlet. Fig. 8 shows a section of vanes used in the tests.

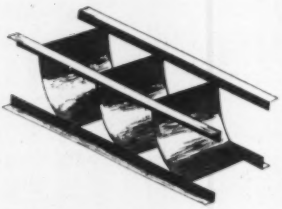

Fig. 8—Section of pre-set, bracketed turning vanes used in test

The necessary supply fan characteristics and power requirements for the outlet would be determined by the pressure ratio (h_v/h_t) corresponding to the selected discharge angles and the quantity of air to be handled. Duct losses between the outlet and the supply fan should be taken into account so that the pressure ratio can be corrected to the required conditions at the fan.

Care should be taken in assuming the correct coefficient of discharge that is to be used in the area ratio. Factors such as orifice construction (sharp- or round-edged slots) and the method used in enclosing the vanes may affect the discharge coefficient.

Under certain conditions guide vanes may not be practical for a slotted outlet. The discharge angle θ may then be selected on the basis of the desired direction of the stream within the conditioned space. Air distribution requirements within the space would then be the governing factor in selecting the proper direction of the supply stream discharge. It should be kept in mind that in choosing too large a discharge angle an impractical design may result, namely, one with a small slot area, a large duct size, and a high static pressure.

Example of Practical Application

As an example of the design of a slot-type air distribution unit, assume that it is desired to distribute 1500 cfm of primary air from a slot 20 ft long located in the side of a wall of approximately the same length. The supply air is to be distributed in equal quantities per foot of slot length and in a direction nearly perpendicular to the duct axis. This is necessary to uniformly absorb a heavy cooling load within the space without excessive temperature gradients.

The velocity in the supply duct is not to exceed 2000 fpm and the slot is to be sharp-edged. Throw limitations will not be considered in order to simplify the example.

Required: Duct size, slot width, static pressure in duct, and a means of introducing the primary air uniformly into the space.

Solution: Two possible solutions will be considered for comparison: namely, a design with (1) Turning vanes set for a perpendicular stream discharge installed on the slot face (see Fig. 7), (2) A slot (and duct size) without turning vanes to give an air stream, for example, of 80 deg to the slot face (see Fig. 4). Assume that a standard set of bracketed, 45 deg turning vanes is available for installation. The solutions of both designs are tabulated in Table 1.

The tabulated results indicate an impractical situation for the slot design without turning vanes. The slot width is exceedingly small and is, therefore, impractical. The required duct pressure is 32 times as great as

Table 1—Duct Design Comparison

	80 deg Stream without Vanes	90 deg Stream with Vanes Set for 45 deg
1. Duct size, sq in. (1500 × 144)/2000 = 108 sq in. or	12″ × 9″	12″ × 9″
2. Slot width, inches: Equation 5		
Assume C_d = 0.61		
Cot 80 deg × 108/(12 × 20 × 0.61) = s	0.13	
Cot 45 deg × 108/(12 × 20 × 0.61) = s		0.74
3. Duct velocity pressure corresponding to 2000 fpm, in. water	0.25	0.25
4. Duct pressure ratio h_v/h_t:		
Equation 6 (or from Fig. 6)	0.03	0.50
5. Duct static pressure, in. water, (assume turning and frictional losses negligible)		
Item 3/Item 4 — Item 3	8.10	0.25

the pressure for the vaned slot, resulting in excessive fan power requirements and in objectionable slot velocities. Installation of turning vanes would be the practical solution in this case. The vaneless slot design could be somewhat improved by decreasing the allowable discharge angle, say to 70 deg. This would be permissible if a satisfactory air distribution pattern could be maintained. Furthermore, a decrease in angular direction may cause impingement or *splashing* of the primary air on the adjacent wall at the downstream end of the slot. Another possible improvement in design would result if a larger duct size were selected. If the same discharge angle and area ratio were used, the slot width could then be increased, resulting in lower duct pressures.

Acknowledgments

The authors are indebted to Dr. S. D. Black of the Aeronautical Engineering Division at Case Institute of Technology for his help and suggestions in the theoretical analysis of this special air flow problem, and to Prof. G. L. Tuve for his guidance in carrying out this investigation. The authors also wish to acknowledge the preparation of the diagrams by Miss Ruth Ehrenfeld.

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2. Air Flow Through Outlets in the Side of a Long Duct, by Alfred Koestel (A thesis submitted to Case Institute of Technology in partial fulfillment of the requirements for the degree of Master of Science in Mechanical Engineering, 1949, 83 pages).

3. Control of Discharge Angle of Air from a Long Slot, by Chia-Yung Young (A thesis submitted to Case Institute of Technology in partial fulfillment of the requirements for the degree of Bachelor of Science in Mechanical Engineering, May, 1949, 83 pages).

Party Honors G. L. Larson As He Retires From University of Wisconsin Faculty

More than 200 persons gathered at a dinner in Memorial Hall at the University of Wisconsin, Madison, Wis., May 24 to honor former Society President Gustus L. Larson and his wife on the occasion of his retirement as Professor of Mechanical Engineering at the University after 37 years' service. Professor Larson, whose retirement became official June 30, is widely known as an educator, author, and consulting engineer.

Comprising the attendance at the event were many students, former students, faculty members, society friends, and neighbors. They heard addresses of tribute covering three different phases of Professor Larson's long and outstanding career. M. O. Withey, Dean of the University of Wisconsin, spoke of Professor Larson's splendid work at the school through the years; J. R. Vernon, Society member and former Larson student, recounted some of the Professor's many contributions to ASHVE and to the engineering profession; and Prof. E. F. Bean spoke of Professor Larson as a member of the community.

A few weeks earlier, at the Annual Engineers' day dinner, Ernest Szekely, First Vice President of the Society, also recalled some of Professor Larson's many contributions to ASHVE and then announced that the Wisconsin Chapter was establishing a *Gustus L. Larson Award*, to be given annually to an outstanding University of Wisconsin engineering student.

Mr. Szekely also was on hand for the May 24 party, in addition to more than 20 other Society members. Because of previous commitments, Pres. L. E. Seeley was unable to attend, but wrote a letter to Professor Larson which read, in part: "The occasion of a dinner for you and Mrs. Larson in grateful acknowledgment by your many friends of years of faithful service in the field of engineering education must not pass without testimony to your many contributions to THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS and the profession which it represents. When a teacher of engineering combines service to students, to industry, and to his profession through societies of engineering and acquires many

More than 200 attended the May 24 dinner honoring Prof. G. L. Larson on the occasion of his retirement from the faculty of the University of Wisconsin after 37 years' service. *Above left (l. to r.)* Mrs. Larson, Foster Larson, Professor Larson, Prof. Pat Hyland, Dean M. O. Withey, Mrs. Withey, Prof. E. F. Bean, Mrs. Hyland, Prof. H. E. Pulser, and Mrs. Vernon. *Above right* Dean Withey recounts Professor Larson's splendid work at Wisconsin through the years. *(l. to r.)* Mrs. Pulser, Rex Vernon, Mrs. Larson, Professor Larson, Professor Hyland and Dean Withey

friends in so doing, he may feel that his life has been an ideal one. That certainly has been your case."

Among other Society members attending the party were: S. R. Lewis, F. W. Goldsmith, H. W. Schreiber, Benjamin Spieth, C. H. Randolph, C. J. Reuschlein, G. H. Volk, J. R. Akerman, George Hall, D. W. Nelson, R. E. Nystrom, F. G. Weimer, J. C. White, W. H. Feirn, C. J. Braatz, V. M. Lathers, and D. J. Stewart.

Born in Sweden in 1881, Professor Larson came to the United States when he was 9 years old and was naturalized at 21. He received his engineering degree at the University of Idaho in 1907 and his M.E. at Wisconsin in 1915. While at Idaho, the husky young Larson was active in athletics, playing left tackle on the Northwestern Conference Championship football team of 1905 and competing in the shot put and hammer throw.

From 1907 to 1909, he worked as a test engineer for the General Electric Co. at Schenectady, N.Y. He then returned to Idaho as professor of mechanical engineering and manager of athletics.

It was in 1914 that he came to the University of Wisconsin, where he earned his second degree the following year and also married his charming wife, Dorothy. The Larsons have two children, Dorothy and Foster. In 1920, he became full professor and head of the mechanical engineering department. In 1942 because of illness, he asked to be relieved of that post.

In addition to his activities at the University, Professor Larson was also extremely active in the design of heating and ventilating systems. Among the many buildings served by systems which he designed are: Wisconsin Power and Light Building, Madison, Wis.; Central Illinois Public Service Building, Springfield, Ill.; and Manchester's Department Store, Madison, Wis.

Besides being a member and past president of ASHVE, Professor Larson also holds membership in *The American Society of Mechanical Engineers, The Engineering Society of Wisconsin*, of which he was president in 1933, *The American Association of University Professors, The Society for the Promotion of Engineering Education*, and *The National Association of Power Engineers*.

Other ASHVE positions in which he served include: Council Committees, Nominating Committee, F. Paul Anderson Award Committee, Guide Publication Committee, Committee on Research, and many Technical Advisory Committees.

NEW BOOKLET ON SOCIETY RESEARCH IS ISSUED

A new, 16-page booklet which reviews major developments of ASHVE research and describes the Society's current and long-range research programs was issued recently.

Aptly titled, *Research — Key to Progress*, the booklet points to the following research results as testimony to the Society's part in providing acceptable and comfortable environment: comfort standards for winter and summer; physiological effects of severe environmental conditions; design data for heating systems; thermal properties of building materials; properties of air and water vapor mixtures; cooling load calculations; room air distribution; instruments and measurements.

The booklet points out that the Society is currently engaged in a research program promising early benefits. This program includes studies in the following subjects: air cleaning; air distribution; cooling load; environment laboratory; heating loads; heat flow through glass; human calorimeter; industrial ventilation; odors; panel heating and cooling; sorbents.

For even broader horizons in the future, the booklet continues, the Society has recently charted a long-range course. This long-range research program of most immediate importance deals with: air cleaning; air distribution; combustion; cooling load; heat flow through glass; heat pump; heating loads; hot water and steam heating; human calorimetry; industrial ventilation; insulation; odors; panel heating and cooling; physiological research; sensations of comfort; sound control; weather design conditions.

Any ASHVE member desiring a copy of the booklet may obtain one by writing to Society Headquarters, 51 Madison Ave., New York 10, N.Y.

Committee on Research Inspects Society's Laboratory

Members of the Committee on Research inspect methods of construction of heat meters to be used in the human calorimeter and the environment laboratory (*l. to r.*) Cyril Tasker, R. D. Madison, A. J. Hess, R. S. Dill, C. M. Humphreys (Senior Engineer), L. N. Hunter, and Prof. A. B. Algren

Members of the Committee on Research inspect equipment used in panel heating studies (*l. to r.*) W. A. Grant, R. C. Cross, G. V. Parmelee of the Laboratory staff (hidden), H. A. Lockhart, Nathaniel Glickman, John Everetts, Jr., and T. H. Smoot.

Warm-Air Perimeter Heating—Heat Emitted from Floor Surface† Part I

By J. R. Jamieson*, R. W. Roose** and S. Konzo††, Urbana, Ill.

SUMMARY — The temperature distribution and heat emission of a concrete floor slab, heated by means of a warm-air perimeter duct, have been investigated in the Floor Slab Laboratory at the University of Illinois. The factors considered were duct-air temperature, duct-air velocity, outdoor temperature, edge insulation, and floor coverings.

The rates of heat emission from the floor surface, measured by means of heat-flow meters, were found to be in excellent agreement with calculated rates based upon the use of the King equation for natural convection and the Stefan-Boltzmann equation for radiation transfer. Good agreement was also obtained between the total heat emission determined by an actual heat balance and that based on the preceding equations.

For practical design purposes an average curve has been presented to correlate the net heat emission from the floor with the average duct-air temperature. These results cover only one phase of the complete investigation.

ONE MEANS for providing for low-cost homes has been the construction of basementless structures in which the concrete floor slab is laid on the ground. Such floors are likely to be cold[1,2] unless some provision is made for adequate insulation[3] of the edge of the floor slab and for introduction of some heat into the floor, especially near the edges where the greatest heat loss occurs.

The warm-air perimeter system[4] was devised to eliminate the cold floor at the exposed edge by the application of heat in the peripheral area of the floor. In this system the warm air from the furnace is delivered through sub-floor feeder ducts extending from a plenum chamber under the furnace to the perimeter duct, which is embedded in the floor along the outer walls. A panel heating effect (by radiation and convection) is provided by the warm floor above the perimeter duct, and convection heat is supplied by the warm air which is introduced into the rooms through floor registers located along the outer walls. Hence, all of the heated air leaving the furnace is delivered into the rooms through registers and is returned to the furnace through return-air intakes located at the inside walls or ceiling.

The overall performance of one type of perimeter heating system has been studied[5] in the Warm Air Heating Research Residence No. 3 at the University of Illinois. Since the many variables affecting the heat transfer from the embedded ducts to the room and to the ground could not be studied individually in the Research Residence it was considered desirable to conduct a separate investigation of these various factors over a two-year period in the Floor Slab Laboratory. The overall objectives of the investigation were to determine:

1. The magnitudes of, and decreases in temperature of the air flowing through both the embedded perimeter and feeder ducts.

2. The magnitudes and distribution of the heat losses to the ground and through the edges of the floor slab.

3. The distribution and the magnitude of floor surface temperatures, as well as the heat emission from the floor over the duct (panel effect).

4. The air distribution and the room-air temperature gradients resulting from the use of various types of floor and baseboard registers located along the exterior wall.

5. The temperatures and moisture contents of the underlying soils as well as the effect of soil moisture on edge insulation.

6. The effect of a floor covering on Items 1, 2, and 3.

7. The change in floor surface, room-air, and mean radiant temperatures resulting from the use of different sized windows.

For each of the foregoing objectives a number of independent variables existed or were separately introduced. These variables included the following items:

1. Construction of the floor slabs with four different types of edge insulation.

2. The temperatures and velocities of the circulating air in the perimeter duct.

3. Weather effects, such as outdoor temperature, solar intensity, wind velocity and direction, and precipitation.

In this paper the discussion includes only Item 3 and that part of Item 6 of the overall objectives re-

†This investigation is a part of the cooperative project jointly sponsored by the Engineering Experiment Station of the University of Illinois and the *National Warm Air Heating and Air Conditioning Association*, and is the first of a series dealing with a research investigation conducted in the Floor Slab Laboratory at the University of Illinois.

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**Research Assistant Professor of Mechanical Engineering, University of Illinois. Associate Member of ASHVE.

††Professor of Mechanical Engineering, University of Illinois. Member of ASHVE.

[1]Exponent numerals refer to References.

Presented at the Semi-Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Portland, Ore., July, 1951.

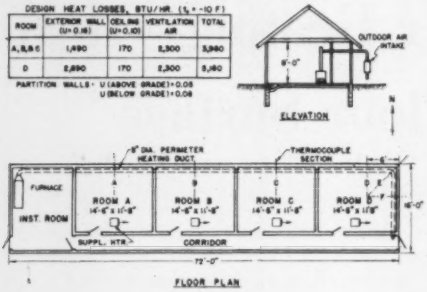

Fig. 1 — Arrangement of experimental rooms in Floor Slab Laboratory

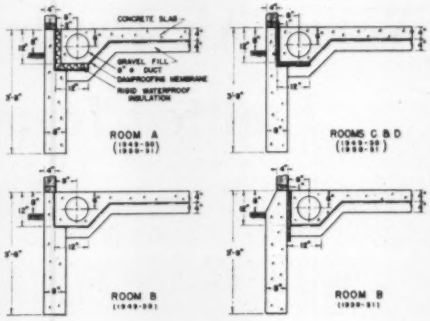

Fig. 2 — Types of edge construction

ferring to heat transfer at the floor surface.

Description of Floor Slab Laboratory

The Floor Slab Laboratory, shown in Fig. 1, was constructed in 1947 for the specific purpose of studying methods of insulating unheated concrete floor slabs.[3] The one-story building was modified in 1949, to accommodate concrete floor slabs with embedded perimeter heating ducts. Further modification was made the following year to provide for the study of objectives 4 and 7. Rooms A, B, and C were exposed only to the north while Room D was exposed to both north and east; thus, the effect of direct solar radiation upon the rooms was minimized. A summary of the overall heat transfer coefficients and design heat losses for each room is also given in Fig. 1. The insulated partition walls between rooms extended 4 ft below the floor to minimize any heat transfer from adjoining spaces.

The four types of floor-slab edge construction investigated during the 1949-50 and the 1950-51 heating seasons are shown in Fig. 2. The edge insulation used consisted of a rigid and waterproof cellular glass, having a thermal conductivity of 0.42 Btu per (hr) (sq ft) (F deg per in.). A 4 in. layer of coarse gravel under the floor provided suitable drainage and minimized the capillary rise of moisture from the soil. A duplex-kraft paper was placed over the gravel fill for a membrane damp-roofing, all the joints being lapped and then sealed with cold tar. The soil under and adjacent to the Laboratory contained 3 ft of fill which was primarily a silty clay composed of 18 percent clay, 53 percent silt, 24 percent sand and 5 percent gravel. Under the fill was the original black silty-clay topsoil which extended to a depth of 4 ft. The soil adjacent to the test rooms was graded 8 in. below the floor line and sloped away from the building for proper drainage.

An electric furnace located in the instrument room supplied warm air to the perimeter duct. For the studies reported in this paper, warm air was not introduced into the rooms from the perimeter duct as is the normal procedure in a residence provided with a perimeter heating system.[4] A supplemental electric heater, controlled by a thermostat, was placed in each room to supplement the heat gains from the perimeter duct and to simulate the heat input through a conventional register. With this arrangement, a constant air temperature of 72 F was maintained in each room at the 30-in. level. A mixture of 20 cfm of outdoor air, corresponding to one air change per hour, and 60 cfm of recirculated air were continuously passed through the supplemental heater. A small flexible damper in each door allowed air to leave the room. The corridor and instrument room were also maintained at 72 F by separate electric heaters. Similar heaters were used in the attic to maintain a temperature of 60 F.

Complete instrumentation for temperature measurement was provided, consisting of approximately 600 thermocouples made of No. 24 B and S gage copper and constantan wires. In addition to the thermocouples used to measure the temperatures of room-air, duct-air, floor surface, etc., a large number of thermocouples were placed in the soil and in the gravel and concrete under each room in a section perpendicular to the axis of the perimeter duct as designated in Fig. 1.

Fifteen heat-flow meters of the Boelter type [6,7] were used for measuring the flow of heat to or from the floor surface, eight of these being located in Room A for a detailed study of heat transfer at the floor surface.

Instrumentation was also provided to measure the relative humidity, the electrical input to the supplemental room heaters, the duct-air velocities, the soil moisture contents, and the level of the water table under the building.

Procedure

The primary purpose of the study reported in this paper was to determine the floor surface temperature distribution and the rate of heat emission to the room by radiation and convection from various parts of the floor surface. The initial phase of this study was made on bare concrete floors. A secondary study of the effect of a floor covering on the heat transfer from the floor surface was conducted in Room A.

Table 1 — Studies Made With Heat-Flow Meters and Thermocouples in Room A

Time of Test		Test Series	Avg Duct-Air Temp F	Avg Duct-Air Velocity (fpm)	Avg Outdoor Temp F	No. of Heat-Flow Meters Installed
Starting Date	Total No. of Hr					
Jan. 11, 1950	72	ABCD-3	134	590	34.5	3
Jan. 31, 1950	72	ABCD-4	157	610	24.8	3
Mar. 2, 1950	24	ABCD-6	106	915	15.0	8
Mar. 24, 1950	24	ABCD-7	106	375	41.6	8
Mar. 29, 1950	24	ABCD-8	106	375	31.0	8
11:00 A.M. Apr. 11, 1950	0[a]	ABCD-9	107[b]	375	39.0	8
12:30 P.M. Apr. 11, 1950	0[a]	ABCD-9	164[b]	375	40.5	8
5:00 P.M. Apr. 12, 1950	0[a]	ABCD-9	185[b]	375	33.0	8
5:00 A.M. Apr. 14, 1950	0[a]	ABCD-9	188[b]	375	25.5	8
2:00 A.M. Apr. 15, 1950	0[a]	ABCD-9	75	375	29.0	8
Jan. 23, 1951	192	A-13	145	150	15.1	8
Feb. 1, 1951	144	A-13a	145	150	15.5	8

[a]Data taken with continuous recorder during transient heat-flow test. [b]During this test the duct-air temperature was suddenly increased, allowed to level off and then rapidly decreased.
[b]Instantaneous temperatures.

Four experimental and analytical methods were available for determining the rate of heat flow from the floors as follows:

Method A. By empirical heat transfer equations — utilizing the measurements of room-air, floor, ceiling and wall surface temperatures and applying them to equations for radiation and natural convection.

Method B. By direct measurement — using heat-flow meters.

Method C. By applying a heat balance — equating the heat gain from the floor surface and supplemental heaters with the above-ground heat losses.

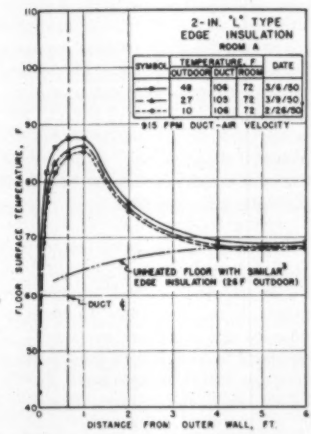

Fig. 3 — Floor surface temperature patterns with unheated and perimeter heated floors

Method D. By heat-flow diagrams — graphically analyzing the temperature pattern in the slab and ground. The method was found to give a qualitative analysis, but the data were not sufficient to give precise quantitative values of heat flow.

Continuous records of outdoor, room-air, duct-air, and other critical temperatures were made throughout the investigation. Daily readings were taken of all thermocouples, heat-flow meters, and duct-air velocities; in addition, the special studies listed in Table 1 were made when relatively stable weather prevailed.

Floor Surface Temperature Distribution

Basementless homes built with concrete floor slabs laid directly on the ground are subject to cold floors, particularly around the periphery of the house where the heat loss from the floor slab is greater than that through the center portion of the floor. Typical patterns of the floor surface temperatures, both with the floor heated and unheated, are shown in Fig. 3. The highest floor surface temperature was observed over the center of the perimeter duct. Furthermore, the floor surface temperature in the peripheral area within four feet from the outer wall were markedly increased by the presence of the heated perimeter duct. The temperature patterns of the heated floor such as shown in Fig. 3 are affected by a number of factors of which the following four are of major importance:

1. *Outdoor Temperature*: For a constant duct-air velocity and temperature, the change in floor surface temperatures resulting from a change in outdoor temperature was small. For example, as shown in Fig. 3, the difference in floor surface temperatures over the center of the duct was only 3 deg for a difference in outdoor temperature of 38 deg. Smaller differences in floor surface temperatures were observed in the center section of the floor. The lower surface temperature of the floor accompanying the lower outdoor temperature has been attributed to an increase in radiation heat transfer from the floor to the cooler surrounding surfaces. However, it should be noted that in an actual residence this reduction in floor surface temperature would not occur since the increased heat demand in cooler weather would automatically bring about an increase in duct-air temperature.

2. *Duct-Air Temperature*: For a constant duct-air velocity and outdoor temperature the floor surface temperatures were markedly affected by the duct-air temperature. For example, the surface temperatures over the center of the duct, as shown in Fig. 4, increased 20 deg when the duct-air temperature was increased by 50 deg. The maximum floor surface temperature of 108 F was obtained with a duct-air temperature of 157 F. In this connection the recommended values for maximum allowable surface temperatures[3] are 120 F for borders and aisles and 85 F for the remainder of the floor.

3. *Edge Insulation*: Previous investigations[1,2] made with unheated floors indicated that the use of edge insulation in-

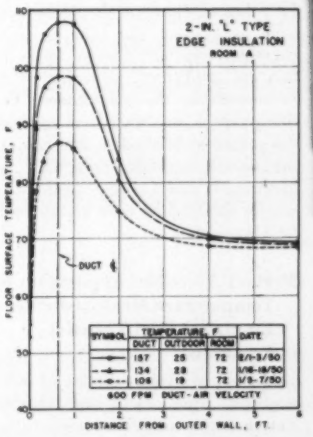

Fig. 4 — Effect of duct-air temperatures upon floor surface temperature pattern

creased the temperature of the floor surface immediately adjacent to the outer wall, but was relatively ineffective as far as the floor surface in the middle of the room was concerned. A similar trend was observed in the present investigation with the floor heated by a perimeter duct.

4. *Duct-Air Velocities*: A large number of observations of floor surface temperatures over the perimeter duct were made with various values of the duct-air temperature. The average curves shown in Fig. 5 were based upon these observed data. In order to avoid confusion, only the observed values for 150 fpm and 600 fpm velocity have been included. A large portion of the scatter of points can be accounted for by the fact that constant outdoor temperatures did not prevail. In general, the curves can be considered to represent an average outdoor temperature of 25 F. The fact that higher floor surface temperatures were obtained with the larger values of duct-air velocities is in agreement with the predicted trends based upon considerations of heat transfer, that is, an increase in duct-air velocity would decrease the thermal resistance of the air film adjacent to the duct surface, and hence would result in a higher floor surface temperature as well as a higher rate of heat transfer to the room.

Determining Rate of Heat Flow from Floor

A considerable disagreement exists in the literature concerning the magnitude of the total heat emission from a heated floor slab. Although the floor slab heated with a perimeter duct exhibits temperature characteristics which differ from those of a fully heated floor, it should be possible to evaluate the heat emission characteristics and thereby to ascertain the validity of the claims made in regards to the magnitude. For this purpose, one analytical method, designated as Method A, and two experimental methods, designated as Methods B and C, were used. The results obtained by each method will be discussed.

Method A — The Application of Temperature Measurements to Empirical Heat Transfer Equations

Method A involves the use of semi-empirical equations of heat transfer. Part 1 of this discussion refers to the radiation component, Part 2 to the convection component of heat transfer, and Part 3 to the total heat emission from the floor. In this study, the heat flow from the floor surface was considered per unit area of floor surface along the center line of the room, perpendicular to the exposed wall.

1. *Radiation*

The transfer of heat by radiation can be expressed by the Stefan-Boltzmann equation:

$$(q_r/A) = 0.173 \times 10^{-8} F_E F_A (T_e^4 - T_s^4) \quad \ldots\ldots (1)$$

where

(q_r/A) = heat loss by radiation to or from the floor, Btu per (hour) (square foot).

F_E = the emissivity factor, dimensionless.

For a large enclosed body, or parallel planes,

$F_E = 1/(1/e_1 + 1/e_2 - 1)$

where e_1 and e_2 are the emissivities of the emitting and absorbing surfaces, respectively[8]. All surfaces were assumed to have an emissivity of 0.90, or a combined effective emissivity, F_E of 0.82.

F_A = the configuration factor. This factor accounts for the shapes and relative positions of the emitting and absorbing surfaces.

T_e = temperature of the emitting surface Fahrenheit, absolute.

T_s = temperature of the absorbing surface Fahrenheit, absolute.

The heat transfer by radiation can be calculated by considering the radiation exchange from the floor to each unheated surface taking into account the shapes and relative positions of the surfaces involved in the exchange. In this procedure, each unit area of the floor is considered to be exposed to a mean radiant temperature which in turn is dependent upon the temperature of each of the surrounding surfaces and the included solid angle which the surface makes with respect to the unit area. This procedure is hereafter designated as the mean radiant temperature, or MRT, method. The heat emission by radiation from a unit area of the floor to the walls and ceiling can be expressed by the summation:

$$(q_r/A) = (q_{rn}/A) + (q_{re}/A) + (q_{rs}/A) + (q_{rw}/A) + (q_{rc}/A) \quad \ldots\ldots (2)$$

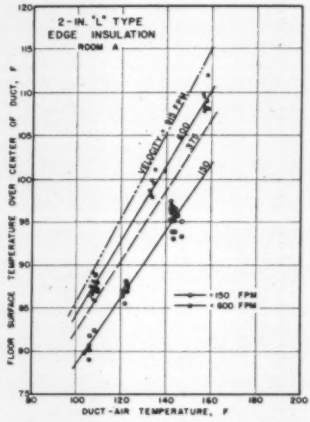

Fig. 5 — Effect of duct-air velocity upon floor surface temperature over center of duct

The subscripts n, e, s, w, c, refer to the respective north wall, east wall, south wall, west wall, or ceiling surface. In terms of Equation 1 this becomes:

$$(q_r/A) = 0.173 \times 10^{-8} \times 0.82 [F_{An}(T_f^4 - T_n^4) + F_{Ae}(T_f^4 - T_e^4) + F_{As}(T_f^4 - T_s^4) + F_{Aw}(T_f^4 - T_w^4) + F_{Ac}(T_f^4 - T_c^4)] \quad \ldots\ldots (3)$$

The temperature, T_f, was the floor surface temperature of each unit area. The configuration factor F_A must be evaluated for each unit area of the floor with respect to each separate wall or ceiling surface. The values shown in Fig. 6 were determined by the graphical method of Hottel,[9] and were used with Equation 3 for the determination of the radiant heat transfer component of the total heat flow at the floor surface.

The preceding MRT method involves tedious computations so that a simpler procedure, designated herein as the AST method, is generally used. In this procedure the temperature of the absorbing surface T_s is assumed to be equal to the weighted average surface temperature (AST) of the walls and ceiling. That is,

$$(AST) = (t_n A_n + t_e A_e + t_s A_s + t_w A_w + t_c A_c)/(A_n + A_e + A_s + A_w + A_c) \quad \ldots\ldots (4)$$

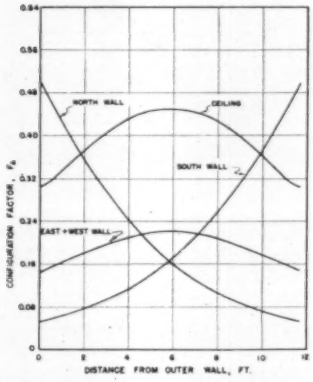

Fig. 6 — Configuration factor, F_A, for a line on the floor surface perpendicular to the center of the outer wall

where

t = temperature of the unheated surface, Fahrenheit.

The value of AST thus obtained and converted to absolute temperatures replaces the temperature T_a in Equation 1. Also, a value of 1.0 is used for the configuration factor F_A.

Both the MRT and the AST methods were applied to a specific condition for which the surface temperatures are shown in Fig. 7*a*. The resulting radiation components of heat transfer from the floor are shown in Fig. 7*b*. In general, the MRT method produced higher results than those by the AST method for the section of the floor studied. The largest deviation, which was only 2 Btu per (hr) (sq ft), occurred directly over the center of the perimeter duct. The deviation can be attributed to the fact that in the MRT method the large solid angle generated by the cold outer wall was taken into account, whereas in the AST method the temperature of the cold north wall was given the same weight as that for the warmer south wall and the configuration factor of both walls was considered to be the same. Since the MRT method gives precise results, it was used throughout this analysis.

2. Convection

The convection component of total heat emission from the floor can be determined from semi-empirical equations which depend upon experimental evaluation of the numerical constants. No single equation for heat transfer by natural convection from a horizontal surface to the air above has been unanimously accepted. Most of the equations have been reduced to the following simple form:

$$(q_c/A) = K\,\theta^n \quad \ldots\ldots\ldots\ldots (5)$$

where

(q_c/A) = component of total heat emitted by natural convection, Btu per (hour) (square foot).

θ = temperature difference between the surface and the air, Fahrenheit. The point of measurement of the air temperature has not been clearly defined, but is assumed to be in the turbulent region immediately adjacent to the laminar layer that lies along the surface.

K and n are constants which depend on the following factors: (*a*) position of the surface (horizontal, vertical, etc.); (*b*) direction of heat flow (to or from the surface); (*c*) magnitude of the temperature difference; (*d*) mean temperature; (*e*) point of measurement of the air temperature; (*f*) size of the surface; (*g*) roughness of the surface.

Table 2 lists a large number of values of K and n, as reported by a number of investigators, together with some physical details of the original experimental studies. The objective of this investigation was to determine whether Equation 5 was applicable to a floor surface with a non-uniform temperature and under both steady state and transient heat flow conditions.

The heat-flow by natural convection at the floor surface was calculated by means of each of the following equations:

1. For the section of floor *warmer* than the adjacent air

$(q_c/A) = 0.81\ \theta^{1.32}$ (Wilkes and Peterson) .....(6)

$(q_c/A) = 0.48\ \theta^{1.25}$ (Nusselt, Henky) (7)

$(q_c/A) = 0.38\ \theta^{1.25}$ (Griffiths and Davis, McAdams) .....(8)

$(q_c/A) = 0.28\ \theta^{1.32}$ (King) .....(9)

2. For the section of floor *colder* than the adjacent air

$(q_c/A) = 0.38\ \theta^{1.00}$ (Wilkes and Peterson) .....(10)

$(q_c/A) = 0.22\ \theta^{1.33}$ (Nusselt, Henky) .....(11)

$(q_c/A) = 0.21\ \theta^{1.33}$ (Griffiths and Davis, McAdams) .....(12)

$(q_c/A) = 0.15\ \theta^{1.33}$ (King) .....(13)

In the range of floor surface and room-air temperatures encountered with residential heating systems, the results obtained by the use of the equations of Jakob and Heilman pro-

Table 2 — Heat Emission by Natural Convection From a Horizontal Plane Facing Upward

Original Investigators						Other Sources Referring to Same Data						Size of Surface Used		Range of Surface Temp Used	Range of Temp Diff., θ, Used
Name	Ref No.	Values of K and n* Heat Flow Upward		Heat Flow Downward		Name	Ref No.	Values of K and n* Heat Flow Upward		Heat Flow Downward		Length	Width		
		K	n	K	n			K	n	K	n	Ft	Ft	F deg	F deg
Wilkes and Peterson	10	0.81	1.12	0.38	1.00	——	——	——	——	——	——	8	2	80	5-17
Nusselt and Henky	11	0.48	1.25	0.22	1.25	——	——	——	——	——	——	——	——	——	4-100
Griffiths and Davis	12	0.38	1.25	0.21	1.25	McAdams	9	0.38	1.25	0.21	1.25	3-4	3-4	78-226	25-172
						King	13	0.28	1.33	0.15	1.33				
						Jakob	14	0.275	1.33	0.14	1.33				
						Heilman	15	0.32	1.27	0.16	1.27				

*Values of K and n are those in the equation: $(q_c/A) = K\,\theta^n$

duced essentially the same values as those by the King equation.

The room-air temperatures were measured at seven levels and at seven stations in the rooms. Preliminary observations indicated that the small temperature differences existing between the air and surrounding surfaces produced a negligible error in the temperature observations due to thermal radiation from the surrounding surfaces to the thermocouples. Only those temperature readings at the 1-in. and 3-in. levels were considered applicable in the convection equations. Such observations, shown in Fig. 7*a* for a cold day, did not show a difference of more than 1 deg for any given station. The values of the temperature difference Θ were obtained by subtracting the room-air temperatures at the 1-in. level from the temperature of the floor surface immediately below.

3. Total Heat Emission

The convection Equations 6 to 13 were used individually in conjunction with the radiation Equation 3 to obtain values of the total heat emission rate (q_t/A) at various distances from the outer wall. These values were plotted as shown by the four broken-line curves in Fig. 7*c*. Similar calculations of the total heat emission rate, utilizing the air temperatures at the 3-in. level for the evaluation of Θ in Equations 6 to 13, resulted in an increase of 1.4 percent over the center of the duct and a decrease of 2.0 percent at the center of the room. It can be concluded that for practical applications the air temperature at either the 1-in. or 3-in. levels can be used in evaluating Θ. A comparison of these calculated results by Method A with the measured results of Methods B and C are given in the following sections.

Method B — Heat Emission as Measured by Heat-Flow Meters

The eight heat-flow meters in Room A were located on the floor adjacent to the temperature measuring stations and at locations 0.5, 0.83, 1.25, 2, 3, 4, 5, and 6 ft from the outer wall. A confirmation of the meter calibrations, furnished by the manufacturer, was made at the end of the heating season. An additional calibration made on one of the meters by the *National Bureau of Standards* showed an agreement within 3 percent of that supplied by the manufacturer.

The results obtained with the heat-flow meters are shown by the solid-line curve in Fig. 7*c*. Both the calculated and experimental data as represented by the curves indicate an upward heat flow in the peripheral area of the floor and a small downward heat flow in the center area of the room. For distances greater than 2.5 ft from the outer wall the measured heat emission rates by the heat-flow meters were in excellent agreement with the calculated rates based upon radiation Equation 3 and the convection Equations 6 to 13. For distances closer to the outer wall a good agreement was obtained between the measured and calculated values, particularly in the case of the application of the King Equation 9. The total heat emission rates calculated by means of the convection Equations 6 and 7 were only in fair agreement with the measured rates, and were from 12 to 25 percent higher than the values of King. Since the King Equation 9, and to some extent the McAdams Equation 8, showed the best correlation with the measured results, all subsequent comparisons were made only with Equation 9.

The only noticeable discrepancy between the calculated and measured heat emission curves of Fig. 7*c* was observed in that portion of the curve representing the heat flow from the floor immediately above the perimeter duct. Part of this discrepancy may be attributed to the radial pattern of heat flow from the perimeter duct which produced a lower temperature differential across the hot and cold junctions of the thermopile in the heat-flow meters, and, consequently, a reduced and fictitious value for heat flow.

The data shown in Fig. 7*c* were obtained under steady-state conditions of heat flow. A supplemental study was conducted to determine the rates of heat emission from the floor surface under transient conditions of heat flow. Prior to the start of this

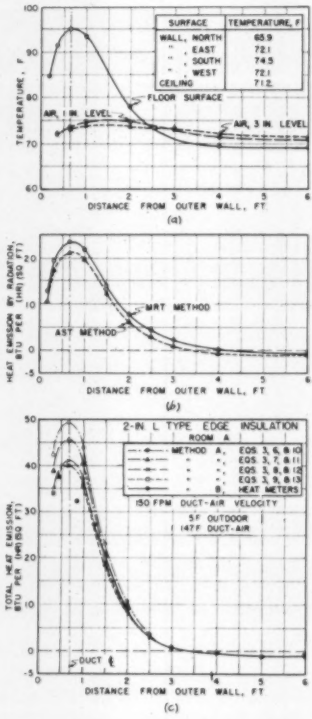

Fig. 7 — Comparison of Methods A and B for a cold day. (*a*) temperatures used (*b*) heat emission by radiation (*c*) total heat emission

study, both the velocity and temperature of the air in the perimeter duct were maintained at constant values. The heat input to the perimeter duct was then doubled, causing the duct-air temperature to rise from 107 F to 157 F in 1½ hr. During this heating phase, the floor surface temperature directly over the perimeter duct increased, attaining a rate of 8 deg per hr approximately 1½ hr after the heat input was increased. The increased heat input was maintained for several days until new steady-state conditions prevailed. The heaters in the electric furnace were then disconnected at the beginning of the cooling phase, and cold air was circulated through the perimeter duct, thus causing a rapid reduction in duct-air temperature. The cooling rate of the floor surface above the

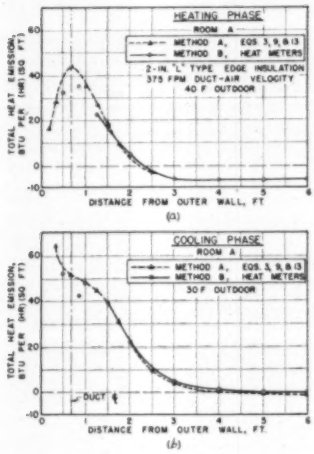

Fig. 8 — Heat emission from floor surface under transient heat flow conditions (*a*) heating phase (*b*) cooling phase

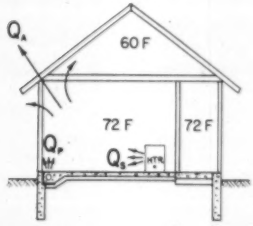

Fig. 9 — Designation of terms used in Method C

perimeter duct was 14 deg per hr about 1½ hr after the heaters were disconnected.

During this entire study the outdoor temperature remained relatively constant between 30 and 40 F. Measurements of temperature and heat flow were made during both the heating phase and cooling phase approximately 1½ hr following the initial changes in duct-air temperature. The measured rates obtained by heat-flow meters are shown as solid lines in Figs. 8*a* and 8*b*. As in the previous discussion, calculated rates of heat transfer incorporating values from Equations 3, 9, and 13 were determined from the actual instantaneous temperatures. These calculated rates are shown as broken-line curves in Figs. 8*a* and 8*b*. A comparison of the calculated and measured rates shows good agreement between the theoretical and experimental results during these transient conditions.

Method C — Heat Flow as Determined by Applying a Heat Balance

In both calculated Method A and the experimental Method B, the floor area under consideration was a center strip (only one unit in width) running from the outer wall to a point six feet from the wall. Furthermore, with both methods it was possible to obtain a heat-flow pattern, or gradient, of the types shown in Figs. 7*c*, 8*a*, and 8*b*. The integrated heat flow from this center strip of one unit width is represented by the area under the curves. If the assumption is made that the heat-flow pattern of the center strip is an average pattern for all of the unit-width strips in the room, the integrated heat flow from the entire floor can be obtained by multiplying the integrated heat flow from the center strip by the number of such incremental areas included in the entire floor area.

Since the actual heat losses through the walls and ceiling were offset by the heat gain from the heated floor and that from the supplemental heaters, as shown in Fig. 9, a method was available for evaluating the heat gain from the floor without recourse either to temperature measurements alone (Method A) or to direct measurements by means of heat meters (Method B). Specifically, the procedure designated as Method C involved a heat balance of the following nature:

$$(Q_p/L) = (Q_s/L) - (Q_a/L) \quad \text{.....(14)}$$

where

(Q_p/L) = Net heat emission from floor, or panel effect, Btu per (hour) (linear foot of exposed edge). In this study the *net* heat emission represents the heat emitted from a strip of floor one-foot wide and 12 ft in length perpendicular to the outer wall.

(Q_s/L) = Above-ground heat losses, Btu per (hour) (linear foot). The heat losses from the room included transmission losses through the exposed walls and ceiling and the heat required to warm the incoming ventilation air. These were grouped together and have been referred to as the *above-ground heat loss*. This was determined by calibration of each test room. In this procedure, 8 in. of mineral wool insulation was placed on the unheated floors, and daily inputs to the supplemental heaters were recorded. The small amount of heat flow through this insulation was subtracted from the heat input to the supplemental heaters, to obtain Q_s. These values were found to be in close agreement with calculated heat losses.

(Q_s/L) = Heat input to supplemental heater during normal operation of the room, Btu per (hour) (linear foot).

The required data included daily records of outdoor, attic, ventilation, and room-air temperatures, and the electrical input to the supplemental heaters. These data were obtained throughout both heating seasons.

The four factors that were shown to affect the temperature distribution of the floor surface were also considered to affect the net heat emission from the floor surface and were therefore investigated in detail as follows:

1. *Duct-Air Temperature:* The curve in Fig. 10*a*, for an average duct-air velocity of 600 fpm, indicated that an increase in perimeter duct-air temperature resulted in a greater net heat emission from the floor surface.

2. *Duct-Air Velocity:* Data are also shown in Fig. 10*a* for duct-air velocities of 150, 375, and 915 fpm. The greater heat emission rates, resulting from the use of higher velocities, was attributed to the reduction in thermal resistance of the inside air film of the perimeter duct. The negative heat emission rates, as shown by the few points in Fig. 10*a*, were obtained with the combination of low duct-air temperatures and velocities. These negative rates occurred when the heat emitted from the section of floor over the perimeter duct was not sufficient to offset the downward heat loss in the remaining area of the floor.

3. *Outdoor Temperature:* The scattering of the points representing a fixed velocity and duct-air temperature was partially due to the effect of outdoor air temperature. For example, the group of eleven points indicated by the open circles in the right hand portion of Fig. 10*a* were obtained for a range of outdoor temperatures varying from 15 to 45 F. In order to show the

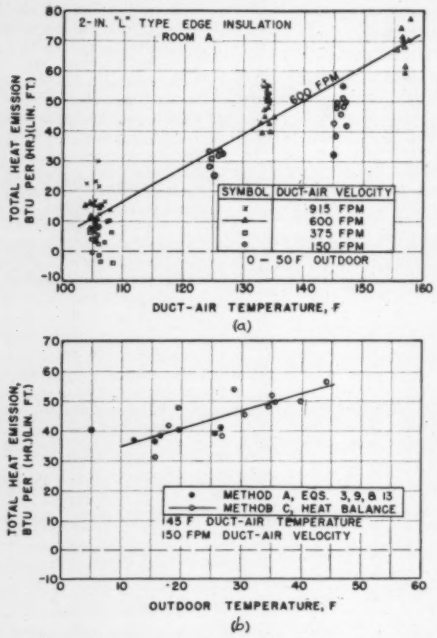

Fig. 10 — Net heat emission as affected by (*a*) duct-air temperature (*b*) outdoor temperature

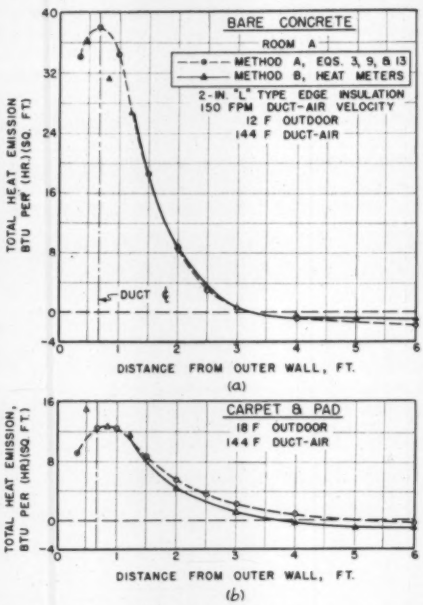

Fig. 11 — Comparison of heat emission from (*a*) bare concrete floor (*b*) carpeted floor

effect of outdoor temperature alone, that is, with constant duct-air temperature and velocity, these eleven points were replotted as shown in Fig. 10*b*. The fact that the heat emission rate increased as the outdoor temperature increased has been attributed to the smaller edge losses and the accompanying higher floor surface temperatures over the perimeter duct. It should be kept in mind that the trend shown in Fig. 10*b* is not directly applicable to the normal operation of a perimeter heating system in a residence since a constant, rather than a variable, duct-air temperature has been maintained.

4. *Edge Insulation:* While the application of insulation at the edge of the slab raised the temperature of the floor at the extreme outer edge a slight amount, and hence resulted in a slight increase in heat emission, the increase was not of great consequence. However, as will be shown in a later report, the edge insulation was effective in reducing the magnitude of heat loss outward through the edge.

The data shown in Fig. 10*b* provide a means for comparing the results by Method C with those by Method A. The solid circles in Fig. 10*b* represent the heat emission rates based on Method A. These rates were determined by integrating the area under curves of the type shown in Fig. 7*c*. The rates thus obtained were found to be in good agreement with those by the heat balance method. Furthermore, similar comparisons at other duct-air temperatures and velocities showed equally good agreement.

Effect of a Floor Covering

The preceding discussion was based on the heat emission from bare concrete floors. Much speculation has been made as to the effect on the rate of heat emission by the application of a floor covering on a heated floor. In general, the application of any floor covering should reduce the rate of heat emission from the floor due to the additional thermal resistance. However, in the case of rugs or carpets, the possibility has been suggested that the floor covering might increase the heat emission by convection because of the additional surface added by the many fibers in the rug or carpet.

For this phase of the investigation a wool carpet and pad were selected having the following physical properties:

	Carpet	Pad
Material	Woolen felt	Jute
Size, ft	9 x 12	8.75 x 11.75
Weight, lb	26.7	25.0
Thickness, in.	3/8	5/8

The carpet and pad were placed on the floor of Room A with the edge of the carpet flush with the outer wall. The study was conducted during Series A-13a (Table 1) with the duct-air temperature and velocity maintained as in Series A-13, with a bare concrete floor. The heat-flow meters remained on top of the concrete floor and were below the carpet and pad.

Typical heat emission curves for both bare and carpeted floors under similar conditions of operation are shown in Figs. 11*a* and 11*b*. The application of the carpet caused a marked decrease in the rate of heat

emission from the heated floor near the duct and little difference in downward heat flow in the center section of the room. The *net rate* of heat emission of the bare concrete floor, as determined from the area under the curves in Fig. 11*a* was 37 Btu per (hr) (linear ft) whereas the rate for the carpeted floor was 21 Btu per (hr) (linear ft). For a constant duct-air velocity and temperature, therefore, the application of a carpet and pad to the floor surface reduced the heat emission approximately 45 percent. While this percentage reduction in net heat emission was large, heat delivery to the room of a residence equipped with a perimeter heating system would not be seriously affected. As was previously mentioned, only a portion of the total heat is emitted through the floor surface and into the room, the remainder being delivered from the registers. As a matter of fact, the system has self-balancing characteristics since any reduction in heat emission from the floor surface would be partly compensated by an increase in register heat delivery.

Comparison of the curves in Fig. 11*a* for the bare concrete floor also shows good agreement between the experimental results obtained by direct measurements of heat flow (Method B) and those obtained by the application of temperature measurements to the proper heat transfer equation (Method A). In the studies where the floor was covered with a carpet, as shown in Fig 11*b*, the calculated results were slightly greater than those obtained by direct measurement. The discrepancy was probably due to the difficulties in obtaining a true temperature of the carpet surface. For this purpose the thermocouples were taped to the surface of the carpet and probably gave temperature readings that were slightly high[16].

Conclusions

The perimeter duct installation discussed in this paper consisted of an 8 in. diameter galvanized-iron duct embedded in concrete and located with the center 6 in. below the floor surface and 8 in. from the outer wall. None of the air flowing through the perimeter duct was discharged into the room. The following discussion applies specifically to this arrangement.

The perimeter duct embedded in the concrete floor around the periphery of the building supplied heat to the floor over an area 3 to 4 ft wide. *Increases* in duct-air temperature, duct-air velocity, outdoor temperature, and amount of edge insulation increased both the floor surface temperatures and the amount of heat emitted from that area. One of the limiting features of any floor heating system is the magnitude of the floor surface temperatures experienced. In this connection the ASHVE GUIDE[8] in Chapter 23 recommends 120 F as the maximum floor surface temperature for floor areas at the border of a room. Results of this investigation indicated that in order to obtain a floor surface temperature of 120 F an average perimeter duct-air temperature in excess of 180 F would have been required. However, since current practice[17] in warm air heating of residences utilizes a maximum bonnet-air temperature of only 165 F at design conditions, little danger exists of attaining floor surface temperatures as high as 120 F.

Three independent methods for determining the heat emission rates from a floor surface were investigated. In Method A both the radiation and convection components of heat transfer from the floor surface were separately calculated by means of available equations. The radiation component, as defined by the Stefan-Boltzmann equation, was determined by two different procedures. The mean radiant temperature (MRT) method of calculating the radiation heat transfer provided slightly higher results (1.4 - 2.0 percent) than did the average surface temperature (AST) method. The convection component of heat transfer was determined by means of eight empirical equations, four of which applied to the section of the floor warmer than the room air, and the remainder of which applied to the section of floor cooler than the room air. The calculated heat flow using the King equation for convection and the Stefan-Boltzmann equation for radiation was found to be in excellent agreement with the experimental determination of heat flow by the use of heat-flow meters (Method B).

The calculated values of Method A using both the King and Stefan-Boltzmann equations were also found to be in good agreement with the total heat emission from the floor surface as determined by a heat balance (Method C). It was concluded that the King equation for natural convection and the Stefan-Boltzmann equation for radiation provided means for predicting the heat emission from a perimeter heated floor from known temperature measurements.

For practical design purposes an average curve has been presented to correlate the *net* heat emission from the floor with the average duct-air temperature. In this study the *net* heat emission represents the heat emitted from a strip of floor 1 ft wide and 12 ft in length perpendicular to the outer wall. For average duct-air temperatures of 120 F, 130 F, and 140 F the corresponding *net* heat emission rates were 28, 39, and 50 Btu per (hr) (linear ft of exposed edge). For rooms other than 12 ft in width, a correction for a downward heat flow must be made. If the room is over 12 ft in width, the correction amounts to −2 Btu per (hr) (ft of width) and for rooms less than 12 ft in width the correction amounts to +2 Btu per (hr) (ft of width). The placement of a carpet and pad over the floor resulted in net heat emission rates approximately one-half of those for the bare floor for the same conditions of duct-air temperature and velocity.

The magnitudes of the heat emission from a perimeter duct to the room can be best shown from an example. Consider the case of a 24-ft x 32-ft residence having a peripheral length of 112 ft. A perimeter heating system for such a residence which maintains an average perimeter duct-air temperature of 140 F would develop a net heat emission, or panel effect, of about 5600 Btu per hr.

This panel effect from the perimeter duct alone would be supplemented by the heat gain from the radial feeder ducts leading from the sub-floor plenum to the perimeter ducts. The magnitude of the panel effect from the feeder ducts would depend on the arrangement and lengths of the feeders. The total heat emission from both the perimeter and radial feeder ducts would represent a substantial portion of the total heat required to offset the heat loss from the structure. The balance of the total requirements would be offset by the heated convection air discharged from the registers. Any reduction in the heat emission from the floor surface by the application of carpeting would be partially offset by an increase in the convection heat delivery through the register.

Also, it is of interest to note that in the example mentioned, a heated floor area 3 ft wide extending around the entire periphery represents 37.5 percent of the total floor area. When consideration is given to the additional floor area heated by the feeder ducts, over one-half of the floor area of the small residence would be serving as a floor panel. Strictly speaking, therefore, the warm-air perimeter heating system can be classified as a convection-panel system.

Acknowledgments

This paper is a report of an investigation conducted in the Floor Slab Laboratory under the terms of a cooperative agreement between the *National Warm Air Heating and Air Conditioning Association* and the *Engineering Experiment Station of the University of Illinois*.

This paper includes material from a thesis completed under the direction of Prof. S. Konzo and submitted in partial fulfillment of the requirements for the degree of Master of Science in Mechanical Engineering by C. R. Remke. These results will ultimately comprise part of a bulletin of the University of Illinois Engineering Experiment Station.

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HELP WANTED: 30,000 ENGINEERS YEARLY

The United States is in urgent need of engineers, more than 30,000 graduates being required yearly if we are to staff the national effort to out-design, out-produce, and out-perform a potential enemy who outnumbers us greatly, the Engineering Manpower Commission of the Engineers Joint Council revealed recently.

But in order to achieve this figure, which is a conservative estimate, engineering schools will have to double their present enrollment for years to come. Because the *mortality rate* in engineering schools is about 50 percent, an annual freshman enrollment of 60,000, double the number that entered engineering schools this year, would be required to produce 30,000 engineering graduates a year, it was disclosed.

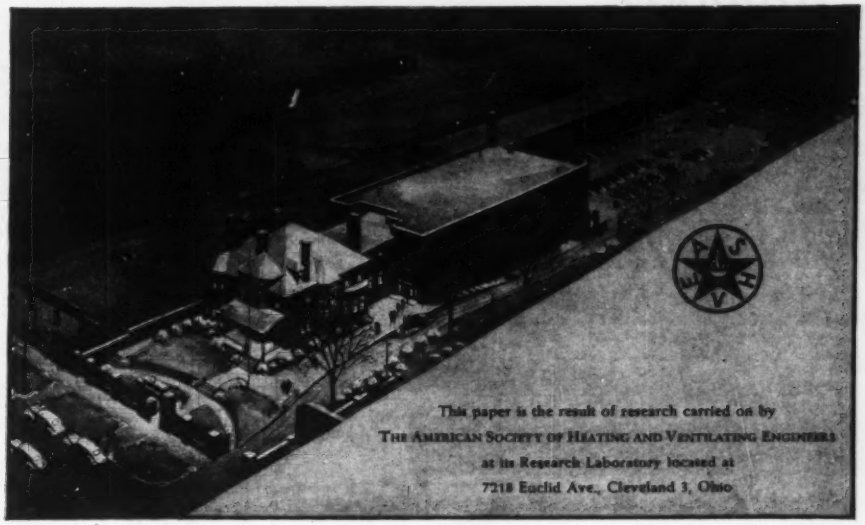
AIEE MEETINGS

Two general meetings of the *American Institute of Electrical Engineers* are scheduled for late Summer and Fall, it was announced recently.

The first is the Pacific General Meeting, which will be held in Portland, Ore., Aug. 20 to 23, and the second is the Fall General Meeting, to be held in Cleveland, Ohio, Oct. 22 to 26.

GAS INDUSTRY CAN AID U.S. DEFENSE PROGRAM

At least a partial solution to the problem of fueling the nation's defense program is available in the vigorous and growing natural gas industry, F. O. Hess, president of the *Gas Appliance Manufacturers Association*, said at the opening of the group's 16th annual meeting recently. He further stated that gas producers and suppliers need only the approval of the Federal Power Commission, and assurance of adequate steel supplies, to launch an expansion program aggregating almost a billion dollars.


This paper is the result of research carried on by
THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS
at its Research Laboratory located at
7218 Euclid Ave., Cleveland 3, Ohio

Laboratory Studies of the Thermal Characteristics of Plaster Panels

By C. M. Humphreys*, C. V. Franks** and L. F. Schutrum***, Cleveland, Ohio

SUMMARY — This paper presents the results of Laboratory studies on four plaster panels, using both non-ferrous tube and ferrous pipe, located both above and below the lath. The panels represented conventional types of ceiling panels.

It is shown that the difference between the average tube temperature and the average panel surface temperature can be related to the heat output from the panel by a simple empirical equation. Effective conductance values are given for the different types of panels for tube spacings of 4 to 12 in.

Relationships between total panel output, tube spacing and the amplitude of the temperature wave on the panel surface are shown in a series of curves. Data and curves show the effect of back insulation on panel performance and some information is given on the effect of back plastering.

THE SOCIETY is engaged in a comprehensive research program on panel heating and cooling. The work described in this report was conducted under the general direction of Group A, Technical Advisory Committee on Panel Heating and Cooling. This group has the responsibility for investigations of heat transfer and temperature distribution within, and behind, the panel.

It is recognized that the heating panel is only one element of the complete thermal circuit in a panel heating system, and that the panel performance is influenced by the space and the five surfaces of the room which it *sees*. In keeping with the scope of the directing committee, this paper deals only with the heat flow to the panel face and the heat flow to the back of the panel. The modifying effects of the surroundings will be studied in a calorimeter room now being constructed at the Research Laboratory, under the direction of Group B of the Technical Advisory Committee.

This report presents the results of laboratory studies on four plaster panels, representing three conventional types of ceiling panels. Secondary effects, such as temperature variations on the panel surface, also are included.

Panel Construction

The plaster panels were constructed on wood frames, 6 ft square, with joists in the test section located 16 in. on centers. The method of framing may be observed in Fig. 1, a view of the back of panel No. 3.

Each panel contained 17 tubes, or pipes, located 4 in. center to center. Details of panel constructions are given in Table 1 and Fig 2.

Plastering was done by an experienced craftsman on the panel frames supported overhead in a horizontal position. Three coats of plaster conforming to the standard specifications for gypsum plastering[1]

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Presented at the Semi-Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Portland, Ore., July 1951.

[1]Exponent numerals refer to References.

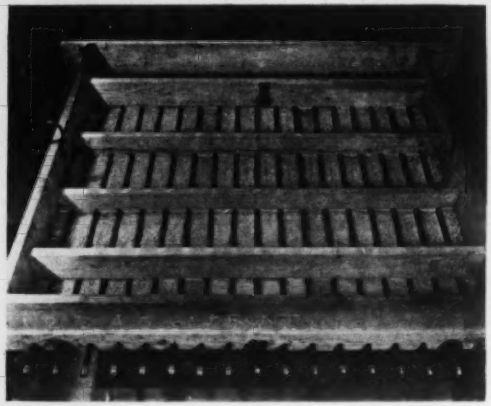

Fig. 1—Back view of panel No. 3 showing framing details

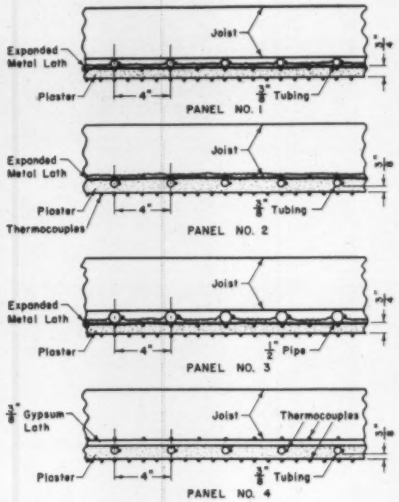

Fig. 2—Plaster panel sections

were applied to each panel. The first (scratch) coat consisted of 1 part unfibered neat gypsum and 2 parts sand, by weight. The second (brown) coat consisted of one part of unfibered neat gypsum and three parts of sand, by weight. The finish coat consisted of 3 parts lime putty and 1 part gaging plaster, by volume.

A *Gypsum Association* representative, who was familiar with field practice, was present to observe and give advice when the first panel was plastered, since it was important to obtain tube imbedment typical of that found in the field.

Test Apparatus and Procedure

Test apparatus and procedures were essentially the same as those used for the concrete panel tests reported in a recent paper.[2] The panel to be tested was placed between two heat absorbers, as shown in Fig. 3. By maintaining the heat absorber temperatures at the proper levels, it was possible to control the heat flow rate from each side of the panel. The heat flow rates were measured by heat flow meters incorporated in the absorber construction. Guards were placed along the four sides of each absorber to eliminate edge losses.

The tubes or pipes imbedded in each panel were connected to headers to form a grid-type coil. A ground key cock was provided on each tube to permit, by selective valving, tests with 4, 8, 12, and 16 in. tube spacings. The temperature of the water to the panel could be held constant at any desired value.

A more comprehensive description of the heat absorbers, fluid circuits, and methods of measurement, is given in a recent paper[2] on concrete panels.

Panel temperatures were obtained by copper-constantan thermocouples located in a line running across the center of each panel at 90 deg to the tubes. For a width of eight tube spaces, the couples were located 1 in. apart as shown in Fig. 2. Across the remainder of the panel, couples on the face of the panel and on the lath were spaced 4 in. apart, each couple being in a vertical plane passing through a tube axis. Thermocouples on the finished panel surface were cemented into small scratches in the plaster. Those on the tubes and metal lath were soldered in place.

In general, each series of tests was made with tube temperatures that were held constant, and with absorber temperatures that were varied to produce heat flow rates of the desired magnitude. Temperature distribution and heat flow rates from both sides of the panel were determined for each test.

Tests were made, without insulation on back of panel, and also with 1½ in. or 3⅝ in. bat-type insulation laid on the back of the plaster. The nominal conductivity of the insulation was 0.27 Btu per (hr) (sq ft) (F deg per in.). Other tests were made with a double yellow pine floor on top of the joists approximately 6 in. above the back of the plaster.

After completion of the initial work on panel No. 1, back-plaster was applied to a depth of approximately 3/16 in. over the bare tubes, from which it was tapered down to the metal lath. The area covered by this back-plaster was approximately 60 percent of the area of the panel. A few tests were then made to compare

Table 1 — Details of Panel Construction

Panel No.	Size and Type of Tubing[a] In.	Location of Tubes	Type of Lath[b]	Depth of Cover[c] In.
1	⅜ non-ferrous	Above lath	Expanded metal	¾
2	⅜ non-ferrous	Below lath	Expanded metal	⅜
3	½ ferrous pipe	Above lath	Expanded metal	¾
4	⅜ non-ferrous	Below lath	Gypsum lath	⅜

[a]Non-ferrous tubing sizes are nominal. Ferrous pipe size is IPS.
[b]Metal lath was diamond key type weighing 2.5 lb per square yard.
[c]Nominal thickness of plaster under tubes.

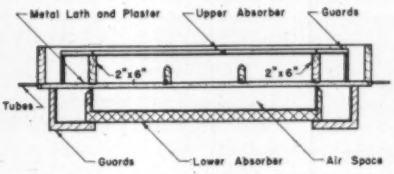

Fig. 3—Sectional view of plaster panel and absorbers

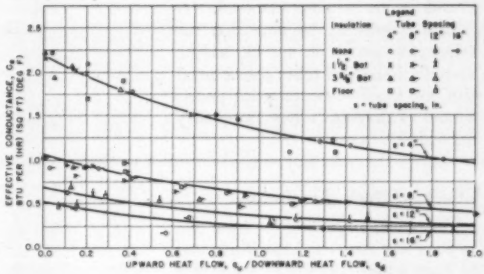

Fig. 6—Computed curves and experimental values of effective conductance: panel No. 1

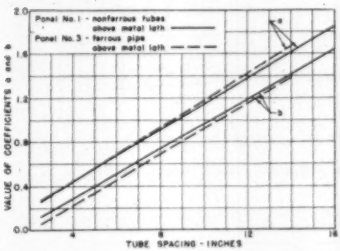
Panel No. 1 - nonferrous tubes above metal lath
Panel No. 3 - ferrous pipe above metal lath
VALUE OF COEFFICIENTS a and b
TUBE SPACING - INCHES

Fig. 4—Coefficients a and b for equation $\Delta T = aq_d + bq_u$: panel Nos. 1 and 3

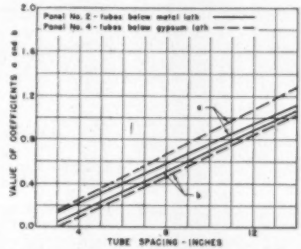

Fig. 5—Coefficients a and b for equation $\Delta T = aq_d + bq_u$: panel Nos. 2 and 4

panel performance with and without back-plaster.

Method of Analysis

Test data were correlated by developing an empirical relationship between panel output and the difference between the average tube temperature and the average panel surface temperature. The relationship is expressed by the equation

$$\Delta T = aq_d + bq_u \quad \ldots\ldots\ldots\ldots (1)$$

where

ΔT = the difference between the average tube temperature and the average panel surface temperature, Fahrenheit degrees

q_d = rate of downward heat flow from the ceiling surface, Btu per (hour) (square foot)

q_u = rate of upward heat flow from the back surface, Btu per (hour) (square foot)

a and b = coefficients, the values of which depend upon tube size and spacing, type of lath, location of tubes with respect to the lath, degree of tube imbedment, and other variables in the panel construction.

ΔT, q_d, and q_u were determined experimentally in each test. For each pair of tests on a given panel with given tube spacing two equations were written. Each involved the same two coefficients, a and b. The values of a and b were determined by solving these pairs of equations simultaneously.

The coefficients a and b of Equation 1 were found to be almost independent of the amount of insulation for a given panel construction and tube spacing. It seemed feasible, therefore, to develop average values for these coefficients that would be applicable for any condition of back insulation. These average values of a and b for the four panels tested are given in Figs. 4 and 5. The experimentally-determined temperature difference for 90 percent of the tests was within 15 percent of the values calculated from the curve values of a and b. While somewhat closer agreement could have been obtained with a different set of curves for each insulation condition, the slight increase in precision that would have resulted did not seem to justify such procedure. It should be noted in Fig. 4 that the values of coefficients a and b for panels 1 and 3 are almost the same. This is to be expected, since the panels are of the same general construction and differ only in type and size of tubes.

Effective Panel Conductance

If the effective conductance of the Panel, C_e, is defined as the downward heat flow in Btu per (hour) (square foot) (Fahrenheit degree difference between average tube temperature and average ceiling surface temperature), then $C_e = q_d/\Delta T$, or by Equation 1

$$C_e = q_d/(aq_d + bq_u)$$

or

$$C_e = 1/[a + b(q_u/q_d)] \quad \ldots\ldots (2)$$

In Fig. 6, values of effective conductance C_e, calculated from average values of a and b, are plotted against the ratio q_u/q_d for panel No. 1. Experimentally determined points for different conditions of insulation are plotted to show their agreement with the averaged values. The curves of effective conductance shown in Fig. 6 are almost identical with those obtained for panel No. 3, and may be considered typical for panels having partially imbedded tubes located above metal lath.

Fig 7 shows curves of effective conductance C_e *vs.* the ratio q_u/q_d for panel No. 2 (tubes below metal lath). These curves also may be used for panel No. 4 (tubes below gypsum lath) without serious error.

Table 2 gives a comparison of the effective conductances for the four panels. Here, again, it will be observed that the values for panels Nos.

1 and 3 are almost identical. It is also interesting to note that the values for panels 1 and 3, having partially imbedded tubes above metal lath, are much lower than for panels 2 and 4 having tubes completely imbedded.

Effect of Back Insulation

The effect of heat loss from the back of the panel is also illustrated by Figs. 6 and 7. It will be noted that the effective conductance increases as the proportion of back heat loss or the ratio q_u/q_d decreases.

To determine the effect of panel insulation, a special series of tests was made on panel No. 1. In these tests, the absorber and tube temperatures were held constant, while upward heat flow was varied by changing the insulation on the back of the panel. Test results are shown by the bar charts of Fig. 8. From the figure, it is evident that the upward heat flow, q_u, is materially reduced and the downward heat flow, q_d, is increased by back insulation. Thus, with an insulated panel a given rate of downward heat transfer may be obtained with a lower tube temperature than would be required with an uninsulated panel.

Tests with back insulation applied to panels 2, 3, and 4 produced approximately the same results as obtained for panel No. 1. The effects of back insulation, as shown in Fig. 8, may therefore be considered typical for all plaster panels.

A comparison of test data indicated that when both were operated without back insulation, the back

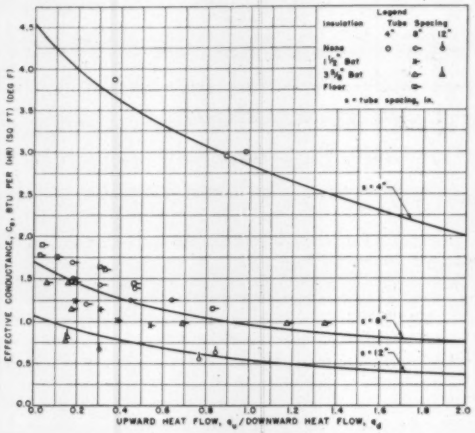

Fig. 7—Computed curves and experimental values of effective conductance: panel No. 2

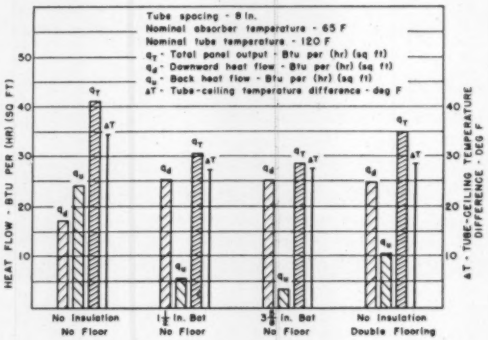
Tube spacing - 8 in.
Nominal absorber temperature - 65 F
Nominal tube temperature - 120 F
q_T - Total panel output - Btu per (hr) (sq ft)
q_d - Downward heat flow - Btu per (hr) (sq ft)
q_u - Back heat flow - Btu per (hr) (sq ft)
ΔT - Tube-ceiling temperature difference - deg F
HEAT FLOW - BTU PER (HR) (SQ FT)
ΔT - TUBE-CEILING TEMPERATURE DIFFERENCE - DEG F
No Insulation No Floor
1½ in. Bat No Floor
3⅝ in. Bat No Floor
No Insulation Double Flooring

Fig. 8—Effect of back insulation on panel performance: panel No. 1

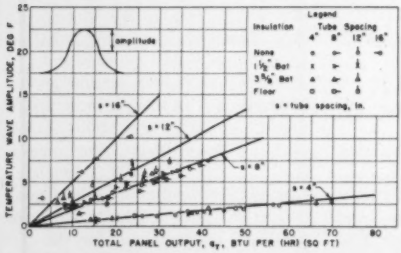

Fig. 9—Termperature wave amplitude *vs.* total panel output: panel No. 1

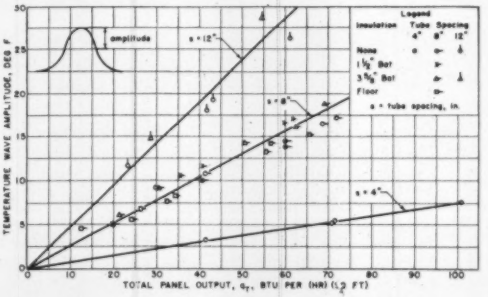

Fig. 10—Temperature wave amplitude *vs.* total panel output: panel No. 2

losses from panel No. 3 were approximately 25 percent higher than for panel No. 1. The greater loss was attributed to the larger area of bare pipe surface on panel No. 3, and the fact that its emissivity was considerably higher than for the non-ferrous tubes on panel No. 1. This difference in back losses, however, disappeared as soon as insulation was applied to the back of the panels. Since good practice requires the use of insulation, there would appear to be no preference for either type of tube on this particular basis.

Table 2 — Values of Effective Conductance, $q_d/\Delta T$

Panel No.	4 in. Tube Spacing			8 in. Tube Spacing		
	$\frac{q_u}{q_d} = 0.1$	$\frac{q_u}{q_d} = 0.4$	$\frac{q_u}{q_d} = 0.7$	$\frac{q_u}{q_d} = 0.1$	$\frac{q_u}{q_d} = 0.4$	$\frac{q_u}{q_d} = 0.7$
1	2.1	1.75	1.5	1.00	0.85	0.70
2	4.3	3.65	3.2	1.55	1.30	1.10
3	2.1	1.8	1.6	1.00	0.85	0.70
4	3.7	3.4	3.1	1.40	1.20	1.00

Table 3 — Data Showing Effect of Back Plastering on Panel No. 1. No Back Insulation, 8 In. Tube Spacing

	No Back Plaster	Back Plaster	No Back Plaster	Back Plaster
Downward Heat Flow, q_d Btu/(hr) (sq ft)	17.2	23.5	- -	- -
Back Heat Flow, q_u Btu/(hr) (sq ft)	24.0	32.5	19.0	26.0
Tube to Avg. Ceiling Temp. Diff., F Deg	34.3	29.5	28.7	24.5
q_u/q_d	1.39	1.39	1.26	1.29
Effective Conductance Btu/(hr) (sq ft) (F deg ΔT)	0.50	0.79	0.52	0.82
		(0.75)[a]		(0.80)[a]
Upper Heat Absorber Temp. F Deg	65.1	64.7	76.4	75.2
Lower Heat Absorber Temp. F Deg	65.5	64.7	75.6	74.7

[a]Values for panel No. 2 for the same ratio of q_u/q_d and the same tube spacing.

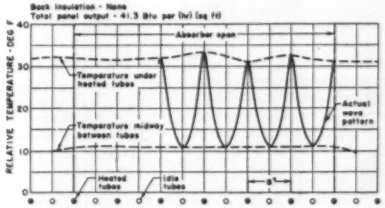

Fig. 11—Relative ceiling surface temperatures under and midway between heated tubes for panel No. 2 (tubes below metal lath)

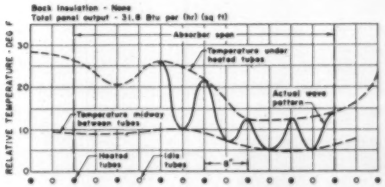

Fig. 12—Relative ceiling surface temperatures under and midway between heated tubes for panel No. 1 (tubes below metal lath)

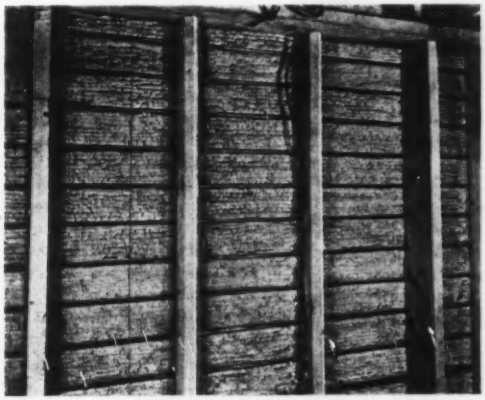

Fig. 13—Back view of panel No. 1

Effect of Back-Plastering

The data in Table 3 have been arranged to show the effect of back-plastering. All tests were made with panel No. 1 without back insulation, and with 8 in. tube spacing. A comparison of the results of two pairs of comparable tests indicates that back-plastering caused an increase in heat flow from both sides of the panel, but that the ratio of the heat flow rates did not change appreciably.

It will be noted that the effective conductance of the panel was increased appreciably by the application of back-plaster. In both pairs of tests the effective conductance for the back-plastered panel compared favorably with that determined for panel No. 2 under similar conditions. Therefore, a panel with tubes above metal lath, which is thoroughly back-plastered, may be expected to perform essentially the same as one in which the tubes are fastened below metal lath.

Surface Temperature Wave

A curve of the surface temperature of a plaster panel along a line perpendicular to the tubes has a regular wave form, showing highest temperatures immediately below the tubes and the lowest temperatures midway between the tubes. The amplitude of the wave increases with the tube spacing and total heat output, and is dependent somewhat upon the type of panel construction. A correlation of the temperature wave amplitude

with tube spacing and total panel output for panels Nos. 1 and 2 is presented in Figs. 9 and 10, respectively. It is evident from the test points shown on the figures that the wave amplitude for a given panel output is independent of back insulation. Curves for panels Nos. 3 and 4 were fairly similar to those shown for panels Nos. 1 and 2, respectively.

The tubes in panels Nos. 2 and 4 were thoroughly imbedded in plaster, and the heat transfer from tube to plaster was fairly uniform as illustrated in Fig. 11 by the curve showing the regular surface temperature wave for a typical test on panel No. 2.

In contrast to the regular temperature wave form shown for panel No. 2, Fig. 12 shows the variation in surface temperature and wave amplitude obtained for panel No. 1. These variations, observed with panels Nos. 1 and 3, were attributed to the nonuniform imbedment of the tubes located above the metal lath. The portion of each tube of panel No. 1 in contact with the plaster was approximately the lower half (see Fig. 13). The pipe surface area in contact with the plaster in panel No. 3 was considerably less than 50 percent and this may be observed from Fig. 1. The actual area of contact, however, was as great, or greater, than in panel No. 1.

It should be emphasized that Figs. 11 and 12 are included only to show the character of the surface temperature wave pattern. The heat transfer rates for the tests shown in the figures are quite different, and the magnitude of wave amplitudes is not comparable.

Conclusions

1. The difference between the average tube temperature and the average panel surface temperature can be related to the heat output from the lower and upper panel surfaces by the empirical equation

$$\Delta T = a\, q_d + b\, q_u$$

2. Insulation on back of a plaster panel serves the following purposes:
   (*a*) It reduces upward heat flow.
   (*b*) It increases the average panel surface temperature for a given tube temperature.
   (*c*) For a given downward heat flow it permits operation with a lower tube temperature than would be required if the panel were uninsulated.

3. A more uniform ceiling temperature *pattern* is obtained with completely imbedded tubes. The temperature wave amplitude is greater, however, on the surface of the panel having tubes below the lath than it is on the surface of a panel having partially imbedded tubes above the lath.

4. The back-plastering of a panel having tubes above metal lath increases its effective conductance to such an extent that its performance is essentially the same as that of a panel with tubes located below metal lath.

References

1. Standard Specifications for Gypsum Plastering, obtainable from The American Society for Testing Materials or the American Standards Association.

2. ASHVE Research Report — Laboratory Studies on Heat Flow Within a Concrete Panel, by C. M. Humphreys, H. B. Nottage, C. V. Franks, R. G. Huebscher, L. F. Schutrum and D. W. Locklin (ASHVE Journal Section, *Heating, Piping & Air Conditioning*, April 1950, p. 109).

TWO ASHVE MEMBERS ELECTED BY *REMA*

Two members of The American Society of Heating and Ventilating Engineers were elected to important posts in the *Refrigeration Equipment Manufacturers Association* at the group's annual Board of Directors Meeting held at the Homestead, Hot Springs, Va., April 29. They are John E. Dube, president, Alco Valve Co., St. Louis, Mo., who was elected treasurer, and James Emmett, Jr., sales manager, James P. Marsh Corp., Skokie, Ill., who became a director of the Association.

Other officers elected were W. A. Siegfried, Pittsburgh, Pa., president; R. L. Sears, Toledo, Ohio, vice president; and L. C. McKesson, Marmetto, Wis., secretary.

Together with R. A. Israel, West Norfolk, Va., who is retiring president, these new officers became the Executive Committee of *REMA* for the fiscal year beginning May 1.

Others elected to the Board of Directors are: J. A. Dugan, Detroit, Mich.; Henry Steinhorst, Utica, N. Y.; J. W. Krall, Niles, Mich.; and H. M. Brundage, Bloomfield, N.J.

Homer Addams
Germantown, Pa.

HOMER ADDAMS RECEIVES HONORARY DEGREE

Homer Addams, Germantown, Pa., charter member of the Society and chairman of the board of the Fitzgibbons Boiler Co., Inc., New York, N.Y., received an honorary doctor of science degree from Albright College, Reading, Pa., on June 4. The degree was conferred upon Mr. Addams *in recognition of his pioneer contributions and long leadership in the heating and ventilating engineering field.* Mr. Addams is an alumnus of Schuykill Seminary, which was the forerunner of Albright College.

PLASTER FAILURE CAUSES REVEALED

Investigation of Failures of White Coat Plaster, a publication presenting the results of tests made on material taken from failed plaster throughout the eastern United States, has been announced by the National Bureau of Standards, U. S. Department of Commerce.

Detailed discussion is given on the importance of the proper preparation of white-coat plaster in order to prevent failures. The text is adequately reinforced by pictures, tables, and graphs.

Copies are available at 25 cents each. They may be obtained by writing to The Government Printing Office, Washington 25, D. C., and requesting Report BMS 121.

Making Hay While It Rains

By Kemble L. Riddle*, Blawnox, Pa.

THROUGH the centuries the farmer has depended on the sun's rays to dry hay for his animals. While this method is adequate to dry hay for most stock, it is known to have a number of disadvantages when used for dairy cattle. Exposure to sunlight tends to destroy the carotene content, the source of vitamin A, which is valuable in the production of high quality milk. It has also been learned that hay, removed of its high moisture content by field drying, suffers still further loss when handled. Here many of the dried out leaves are shaken off and these are higher in carotene and protein than the stems. Hay that is left to dry in the field is also subject to spoilage by rain.

Numerous new approaches in artificial hay drying have been made in an effort to produce a better hay than is generally possible with field drying. The details of one system, that of using oil heat in a mechanical drying process, are given here and on the following pages. The system permits green hay to be baled and hauled to the drier soon after it has been cut, thus preserving the peak feed value of the grass and avoiding the danger of bad weather.

The system described serves a large Pennsylvania dairy farm and was successfully tested during the 1948 haying season. It employs atmospheric air heated by passing over the shell of an oil-fired radiant type furnace, and then blown through the baled hay at approximately 20 cfm per sq ft of drying chamber floor area. This permits fast hay curing and eliminates the danger of mold growth.

Bale Placement Tested

At the outset, there were two differing opinions about the proper placement of bales for maximum drying efficiency. One contention was that the bales should be placed on edge (14-in. dimension). The other maintained that the bales should be placed flat (18-in. dimension). Consequently, a laboratory test was arranged.

A plenum chamber was built and a bale of hay was placed in it. Support for the bale was provided by a 1 in. diamond-mesh screen. Another piece of mesh was placed at the top to hold the bale firmly in the line of the rising air stream. To accommodate the flat dimension of the bale, the plenum box was constructed 18 in. wide. When the bale was to be tested on edge, the remaining four inches in width would be filled with paper.

A duct connection 18 in. in diameter was made in the lower portion of the box, and air was furnished by a centrifugal fan, its quantity being varied by a blast gate at the fan inlet. A tap was provided in the plenum box below the hay to determine static pressures which were varied from 0.3 in. to 3.9 in. water in increments of 0.4 in.

Air velocity through the bales was determined by the averaging of anemometer readings. These were taken at the center of equal areas over the bale tops, eight areas being used for bales on edge and 12 for bales laid flat. Fig. 1 shows the relation of pressure loss through the bale to velocity of air for bales placed on edge and placed flat. Pressure loss was corrected to 18 in. thickness by multiplying the loss for the 14 in. thickness by 18/14. It was evident from this that the pressure loss and air by-pass would be less with the flat placement of bales (Fig. 2) and design of the system proceeded on that basis.

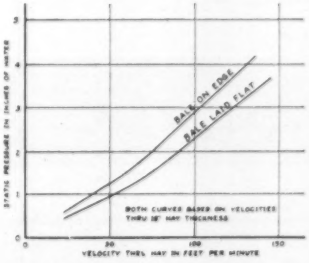

Fig. 1—Comparison of velocities through bale laid flat and bale on edge

Cutting the Hay

The cured hay in this run was cut from 8 acres of 80 percent orchard grass and 20 percent clover, both of which were in full bloom. Moisture content of the hay as it stood in the field was 70 percent water by weight.

It was cut on June 8 in the period from 1:30 p.m. to 7 p.m. and left to field-dry for 42 hr. June 8 and 9, the days of the field drying, were bright, hot and humid. On June 10, a dry, hot day, the hay was raked, baled and hauled to the drying chamber, where some of it was still found to be damp.

At the time of its placement in the drying chamber following the 42-hr period of field drying, the hay contained 45 percent water by weight. After the drying process, it contained 18 percent water by weight. Two samples were dried in an electric oven operating at 225 F and repeated weighings were made until no further weight loss was detected.

The 14 in. × 18 in. × 48 in. bales to be placed in the drier varied in weight from 67 to 129 lb each. About every fifth bale was tagged to record its weight and position in the drier. Total weight of the 650 bales before drying was about 650 × 100 lb (average) = 65,000 lb or 32.5 tons.

Weather during the drying period was not ideal. It varied from hot and humid to cool and cloudy, and there were intermittent rains. The drier, nevertheless, was allowed to operate continuously with the 650 bales from 6 p.m. on June 10 to 9 a.m. on June 14, and the effect of the varying weather is indicated in the data in Table 1.

*Farm Equipment Engineer, Blaw-Knox Co. Member of ASHVE.

Drying Chamber

The drying chamber (Fig. 3) is located in a 24 ft wide × 80 ft long × 10 ft high prefabricated, insulated steel building. It is 24 ft × 40 ft, or exactly half the size of the building, and is elevated two feet above floor level by concrete piers.

Removable wood frames covered by 1 in. sq wire mesh screen provide a supporting grille for the hay. Located directly beneath these frames is the plenum chamber. The only obstruction in the plenum chamber is made by eight concrete piers, these supporting oak stringers, which, in turn, uphold the frames.

Frames are in two sizes. The larger ones, 8 ft wide × 10 ft long, are placed along the outer walls. The smaller ones, 4 ft sq, serve to close up the center area. This arrangement was made to permit the chamber to be used also for corn drying. The larger frames will then be sloped upward toward the outer chamber walls and a trough conveyor placed under the frames in the center. After the corn is dried, the smaller frames will be removed in sequence from front to back, thus allowing the cured corn to roll down the sloping frames and into the conveyor.

Access to the chamber for loading and unloading is through an 8 ft door in the center of the partition on the inside end of the drying chamber. Four roof ventilators, 3 ft 6 in. × 4 ft, permit the removal of moisture-laden air after it has passed up through the mow. These ventilators will also serve as hatches through which corn will be dropped into the chamber for drying.

The drier, itself, is housed in an 8 ft wide, 16 ft long extension located in the center of the outside end of the drying chamber on the ground level of the lower plenum chamber. Entrance of air from the fan, placed against the plenum chamber wall, is through a 3 ft wide opening in a 4 ft high wall. A 2-ft 6-in. high, 14-ft long baffle is placed on the floor 9 ft in front of the fan to cause the air rise up through the hay to be as nearly uniform as possible.

Bale Arrangement

Bales were moved to the mow by a 30 ft trough conveyor powered by a 1 hp geared motor. To prevent air escape up along the walls and through voids in the bales, an occasional bale that had been broken in handling was used as a stuffer. Flat bale placement permitted the first layer, with allowance for creepage, to be 15 bales in width (15 ft × 1 ft 6 in. = 22 ft 6 in.) by 10 bales in length (10 × 4 ft = 40 ft).

Each succeeding layer was then criss-crossed to prevent the drying air from discovering any channels of least resistance. It is of paramount importance in this process that the air pass through the bales, and not between them. Hence, alternate layers were 6 bales wide by 25 bales long. Consequently, with 150 bales to the layer, the 650 bales formed 4 1/3 layers and stacked to a maximum of 5 × 1.17 ft = 6 ft.

The Drier

The drier (Fig. 4) is approximately 5 ft wide by 8 ft high by 11 ft long. It consists of a 36 in. tube-axial fan connected to a 5 hp 1800 rpm, 220 volt, single-phase, repulsion induction motor with double V-belt drive. It also has a 3/16 in. steel plate furnace shell, 3 ft 6 in. in diameter, by 6 ft long, inside a 16-gage steel casing 4 ft 6 in. in diameter by 6 ft 6 in. long, with a 16-gage galvanized transformation piece connecting it to the fan.

The entire unit is mounted on a steel channel frame and is supported by two rubber-tired wheels using 6:00 by 6 in. pneumatic tires. A 1/5 hp high pressure, atomizing oil burner is mounted on the rear circular head of the furnace shell. Above the burner is a 4 in. diameter inspection hole with cover.

A circular plate, 45 in. outside diameter, by 15 in. inside diameter, by 11 gage, with curved edges located 1 in. in front of the forward circular head, causes a portion of the intake air to sweep in front of the furnace shell (see Fig. 2). A duct 9 in. in diameter carries the combustion gases from the back of the shell to the stack, as shown in Fig. 2.

The steel shell and stack absorb and conduct heat from the oil flame to the air flowing through the 6-in. wide annular space that is located

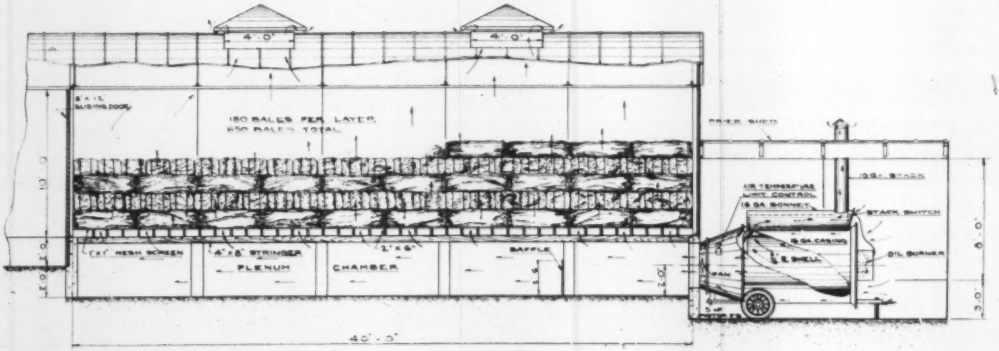

Fig. 2—Section showing air flow

between the inside and outside castings, and the 3½-in. wide space between the stack and the bonnet.

A 275 gal steel tank, 2 ft 3 in. wide, by 3 ft 7 in. high, by 5 ft long, with circular top and bottom, is mounted on concrete blocks just outside the building and is elevated slightly higher than the oil burner. No. 2 fuel oil was used. It was fed from the bottom of the tank through a ⅜ in. gate valve and ⅛-in. copper tubing.

Instrumentation

The following instruments and equipment were used to record test data: four air temperature thermometers; two iron-constantan thermocouples; potentiometer indicator for stack and shell temperatures; hygro-thermograph — recording relative humidity and air temperature; 160 lb oil pressure gage; flue gas analyzer; gas sampling tube; dry-type, portable differential pressure gage; anemometer; tachometer; stop watch; platform scale; single-phase watthour meter, 3-wire, 15-amp, 60-cycle, 240-volt; AC volt ammeter.

The electrical controls used were: line switch, 230 volt, 60 amp 3-pole, single phase; safety switch, 115 volt, 30 amp for oil burner; motor starter for 5 hp, 220 volt, 36 amp single phase; air temperature limit control 110-220 volts, 60 cycle for safety from overheating; continuous ignition stack switch ¼ hp, 110 volt, 60 cycles to cut out burner if oil ignition fails.

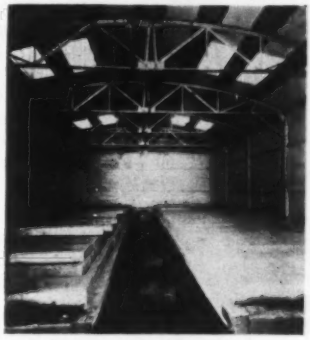

Fig. 3—The drying chamber

Readings

Readings were taken every few hours during the drying operation and data are tabulated in Table 1.

The 5 hp motor speed, as checked with the tachometer, was 1760 rpm. Consequently, with a pulley diameter ratio of 7.4 in. (motor) to 10.6 in. (fan), the fan speed was:

$$\frac{7.4}{10.6} \times 1760 = 1230 \text{ rpm}$$

At 101 F, static suction at the drier shell was −0.7 in. water gage and static pressure in the plenum chamber measured +0.4 in. A slight draft of +0.03 in. water gage was noted over the top of the mow.

Correcting the above static suction and pressure to 70 F in order to determine fan performance, with pressure varying inversely as the absolute temperature, the total static temperature is:

$$p \text{ at } 70\text{F} = (0.7 + 0.4) \times \frac{460+101}{460+70} = 1.16 \text{ in.}$$

The fan capacity table for 1230 rpm fan speed, at 70 F and 1.16-in. static pressure, shows a volume of 17,650 cfm and 5 bhp.

This value for quantity of air Q is verified by the formula for air flow from static readings:

$$Q = 4005\, CA\sqrt{h_s}$$

where,

C = discharge coefficient.
A = area intake, square feet.
h_s = static suction, inches of water.

$$A = \pi(R^2 - r^2) + \pi(R_1^2 - r_1^2)$$

where,

R = radius casing feet.
r = radius furnace shell, feet.
R_1 = radius bonnet, feet.
r_1 = radius stack, feet.
$A = \pi(2.25^2 - 1.75^2) + \pi(0.67^2 - 0.375^2) = 7.3$ sq ft

then

$$Q = 4005 \times 0.71 \times 7.3\sqrt{0.74} = 17,800 \text{ cfm}$$

Further Air Flow Check

A further check on air flow was provided by an anemometer traverse of the intake. It indicated a flow of (average) 2400 fpm at 79 F. The instrument correction for this velocity is (−60). Hence: (2400−60) × 7.3 sq ft = 17,100 cfm.

This air is heated, and at the fan, with temperature averaging 101 F, will contain a volume of:

$$17,100 \times \frac{460+101}{460+79} = 17,800 \text{ cfm}$$

The speed and capacity of the fan are kept constant, the pressure and horsepower varying inversely as the

Table 1—Data Recorded on the Log of Run No. 2

Date	Time	Total Hr	Temp. Atmospheric Air—F	Temp. Air Entering Plenum F	Temp. Rise F	Temp. Top of Mow F	RH Atmos. %	RH Plenum %	Temp. Flue Gas F	Weather
June 10	6 p.m.	0	90	112	22	97	68	36	790	Thursday
	7 p.m.	1	86	108	22	96	68	35	790	bright
	8 p.m.	2	84	105	21	94	67	36	790	hot
	9 p.m.	3	84	104	20	93	68	36	790	humid
	10 p.m.	4	75	96	23	86	80	39	790	day
June 11	8 a.m.	14	72	95	23	86	66	32	800	Friday
	10 a.m.	16	81	105	24	94	40	22	800	hot and
	12 Noon	18	90	117	27	96	36	19	810	dry
	2 p.m.	20	92	112	20	97	40	22	810	
	4 p.m.	22	92	110	18	96	45	27	810	
	6 p.m.	24	88	110	22	96	50	26	810	
	8 p.m.	26	70	95	25	86	74	54	810	
	11 p.m.	29	65	90	25	76	85	58	808	
June 12	8 a.m.	38	65	87	22	74	92	45	800	Saturday
	11 a.m.	41	75	99	24	87	70	33	800	Cool and
	2 p.m.	44	75	98	23	88	52	26	800	cloudy
	4 p.m.	46	77	102	25	89	58	26	800	rain at
	8 p.m.	50	72	94	22	86	64	32	800	8 p.m.
June 13	9 a.m.	63	71	94	23	82	98	47	800	Sunday
	11 a.m.	65	75	95	20	83	97	52	810	intermittent
	2 p.m.	68	84	106	22	90	84	45	810	rains
	4 p.m.	70	83	105	22	92	82	42	800	
	6 p.m.	72	80	102	22	18	80	41	790	
	9 p.m.	75	78	101	23	88	81	40	800	
June 14	9 a.m.	87	67	85	18	75	75	42	790	Monday cool and cloudy

absolute temperature. Thus, as has been shown, the average fan performance is 17,650 cfm at 1.1 in. static pressure at 101 F. Power consumption during the run as read from the watthour meter was 450 kwhr. At 1.5 cents per kwhr, cost of power was 450 × 0.015 = $6.75.

A 4 gal per hour, 45 deg angle spray nozzle was used and oil pressure was maintained at 105 psi. The excess air intake was adjusted to give a clean, yellow flame. A sample of flue gas was taken under average operating conditions and was found to contain 13 percent CO_2. This indicated a reasonable supply of excess air preventing too much absorption of heat from the products of combustion and loss of sensible heat up the stack.

Fuel consumption was 360 gal of No. 2 oil at 12 cents per gallon at a total cost of $43.20. The quantity, as measured by the delivery truck meter, was checked by measuring the oil level in the supply tank both before and after the run.

Balancing Static Loss

Some attempt was made to balance the static loss through the furnace annulus and also that through the stack bonnet. In considering the data in Table 1, and the general averages obtained throughout the run, the following facts are established: Volume air through furnace annulus, 15,900 cfm; volume air through stack bonnet, 1,750 cfm; average temperature rise of air from atmosphere to plenum = 22 F; average temperature of furnace shell and stack = 800 F; average temperature of stack gas = 800 F.

Making allowance for stack loss, the overall efficiency of the furnace is about 75 percent.

Heat transmitted = 4 gal × 138,500 Btu per gal × 0.75 = 415,000 Btu per hr.

Upon checking this with the heat absorbed by the air: 17,650 cfm × 60 × 0.073 lb per cu ft = 77,300 lb per hr. Specific heat of air at constant pressure = 0.24 Btu per (lb) (F deg). Consequently, heat absorbed = 77,300 × 22 F rise × 0.24 = 408,000 Btu per hr.

The inside of the furnace shell, black with soot, is considered a good receptor for the radiated heat from the oil flame. In neglecting the small thermal resistance of the 3/16 in. thick steel plate, and, considering the air film resistance on the outside, the unit conductance for forced thermal convection is:

$$h_c = \frac{q_c}{A(t_1 - t_2)}$$

where,

q_c = heat transmission by convection, Btu per hour.
A = surface area shell, square feet.
$t_1 - t_2$ = temperature difference between the surface and the air, Fahrenheit degrees.

Then,

$$h_c = \frac{408{,}000}{(3.5\pi \times 6 + 0.75\pi \times 6 + 1.75^2\pi)(800-90)}$$
$$= 6.4 \text{ Btu per (hour)(square foot)(Fahrenheit degree)}$$

Using the formula*, the approximate unit conductance for thermal convection for longitudinal air flow in cylinders is:

$$h_c = \frac{0.0036\,G^{0.8}}{D^{0.2}}$$

where,

G = mass velocity, pounds per (hour) (square foot of flow cross section)
R_h = the hydraulic radius of the flow cross-section = flow cross-section area per wetted perimeter, feet.
$D = 4 \times R_H = 4 \times$ (area annulus/wetted perimeter)

So, for furnace annulus

$$D = 4 \times \frac{6.3 \text{ sq ft}}{\pi(3.5 + 4.5)}$$
$$D = 4 \times 0.25 \text{ ft} = 1 \text{ ft}$$

Hence,

$$h_c = \frac{0.0036\,(69{,}600/6.3)^{0.8}}{1^{0.2}}$$
$$h_c = 6.2 \text{ Btu per (hour)(square foot)(Fahrenheit degree)}$$

For the best approximation of unit conductance for air flow in the stack bonnet opening which is not due to the interfering stack elbows and the necessary departure from the true cylindrical shape, we have:

$$D = 4 \times \frac{1 \text{ sq ft}}{\pi(0.75 + 1.33)}$$
$$D = 4 \times 0.153 = 0.61 \text{ ft}$$

Hence,

$$h_c = \frac{0.0036(7700/1)^{0.8}}{(0.61)^{0.2}}$$
$$h_c = 5.1 \text{ Btu per (hour)(square foot)(Fahrenheit degree)}$$

Operating Costs

The weight of the standing grass prior to cutting, at 70 percent moisture content, was 119,000 lb. Water loss during the 42 hr of field drying was 119,000 – 65,000 = 54,000 lb.

Upon their removal from the drier, the 650 bales had an average weight of 67 lb each. The total weight of cured hay at the end of the 87 hr run was 650 × 67 = 43,500 lb, or 21.75 tons. Water removed by the drier was 65,000 – 43,500 = 21,500 lb. Therefore, the cost of fuel oil and electric power in relation to the quantity of hay cured is: ($43.20 for oil + $6.75 for power)/21.75 tons = $2.30 per ton of hay.

Finished hay was fragrant and had a fresh green color. The bales were hauled from the drier and dumped in disorder into the storage mow of the nearby barn. In this way, ventilation is not completely shut off.

In this type of drier, the psychrometric relations are modified by the fact that hay moisture requires more heat for vaporization than free water; that hay stock temperature varies; and also that there may be heat losses by conduction or radiation. Test equipment on hand was

*Heating, Ventilating, Air Conditioning Guide 1950, Chapter 5, Table 2, p. 104.

not elaborate enough to permit collection of complete and exact psychrometric data, but some approximations can be made.

Bulk hay drying is a process of constant total heat, or, more directly, one of constant wet bulb temperature. Wet bulb temperature of the air over the top of the mow is equal to the wet bulb temperature of the air entering the plenum chamber below. On the other hand, the dry bulb temperature drops during the evaporation process and there is an increase in relative humidity.

Heat is absorbed as the moisture in the hay evaporates. Its source for evaporation is mostly the sensible heat in the air. Also, but to lesser extent, it is the sensible heat in the hay itself. With this loss of sensible heat as the air passes through the hay, the temperature differential can be used as a measure of the amount of drying done. In following the line of evaporative cooling or wet bulb line on the psychrometric chart within the temperature range of the drying, it is to be noted that the dry bulb temperature drops about 4.2 F for each 7 grains of water evaporated by one pound of air, or each pound of water evaporated by 1000 lb of air. From the test data, psychrometrically incomplete due to lack of some readings during the nights of operation, the number of pounds of water evaporated by each 1000 lb of air $= 21{,}500/87 \times 77.3 = 3.2$ lb. The expected temperature drop through the hay would then be 3.2×4.2 F $= 13.4$ F. This approximation compares with 12.4 F actual.

As the heated air from the plenum rises through the bottom layer of bales, it will absorb some moisture, then less moisture through the next layer, with its absorption capacity increasingly less in succeeding layers. This is due to its progressively decreasing temperature and increasing humidity. If the air leaves the top layer of hay before coming to moisture equilibrium with it, all the layers will have benefited in the drying. If, however, the air contains all the moisture it can hold as it approaches the top, the drying of the last layer is delayed until the dryer bottom layers will allow the drying zone to move upward. Rate of evaporation at any point in the mow is about proportional to the amount by which the dry bulb exceeds its final equilibrium temperature. Total heat of the air is the same at the top of the mow as at the bottom, but some of its sensible heat is used to supply heat for vaporization, contained in the top air as latent heat.

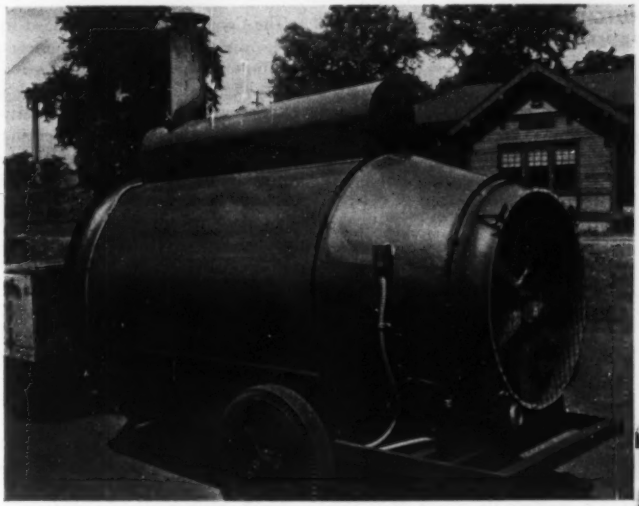

Fig. 4—The drier

Determining Cross-Sections

The 24 ft by 40 ft cross-sections of the drying chamber are determined by these factors.

Air supplied in large volume changes proportionately less in passing through a given thickness of hay than when supplied in small volume. Rate of moisture evaporation in the bottom, intermediate, or top layers of hay, given the temperature and moisture content, is a function of the pounds of air per minute per unit weight of dry hay stock, and is independent of the depth of the mow or air velocity. Therefore, as the air is passed up through the mow, moisture changes are the same whether the hay is in a deep column of small cross-section, or in a shallow depth of large cross-section. Hence, the cross-section's dimensions are to be determined more by structural economy and practicability.

Atmospheric air entering the drier at an average of 79 F and 69 percent RH is delivered to the plenum chamber at an average of 101 F and 35 percent RH. Wet bulb temperature during this sensible heating increases from about 71 F to 77 F. Maximum total heat available from the air is the sensible heat represented here by the drop in temperature from the initial dry bulb of 101 F to the wet bulb of 77 F. The air conditioning process then becomes one of evaporative cooling in which the changing properties of the air may be found by following the wet bulb line of the psychrometric chart.

Conclusions

The installation of an efficient hay drying system represents a sound investment for the dairy man. Such a system will sharply reduce spoilage losses and make possible a cured hay that offers greater nourishment and improved palatability for the cattle, in turn resulting in a more valuable milk yield and significant health benefits for the public.

The design of the efficient hay drying system, indeed, offers an interesting opportunity to the engineer.

HUTCHINSON TO GIVE PAPER IN LONDON

F. W. Hutchinson, a member of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS and professor of mechanical engineering, University of California, Berkeley, Calif., plans to deliver a paper on the

F. W. Hutchinson
Berkeley, Calif.

subject, *Radiant Heating*, before the 1951 *Building Research Congress*, to be held in London, September 11 through 20. Four other papers by Society members will also be presented. The authors and their papers are: C. O. Mackey, professor, Heat Power Engineering, Cornell University, Ithaca, N.Y., — *The Steady Periodic State—A Review of Some Computational Methods;* Dirk Van

C. O. Mackey
Ithaca, N. Y.

Zuilen, director of research, *National Council for Applied Scientific Research*, The Netherlands, — *The Effect of Moisture on the Thermal Conductivity of Building Materials;* Poul Becher, director of research, *The Danish National Institute of Building Research*, Copenhagen, Denmark, — *Heat Insulation in Temperate Climates;* and J. F. L. Grocott, air conditioning engineer, The Anglo Iranian Oil Co., Ltd., Great Britain, — *Air Conditioning in the Tropics.*

The Congress has been planned in three divisions holding concurrent meetings. Papers by Society members will be delivered under Division 3 which will be concerned generally with the various factors influencing the comfort and efficiency of people using buildings. The matters to be discussed include the acoustics of auditoria and broadcasting studios; the heating and ventilation of buildings in relation to summer and winter conditions; the lighting of buildings. In addition, three specific types of buildings — hospitals, factories, and schools — will be considered in the light of all requirements which they must meet if they are to fulfill their purpose.

EIC HOLDS ANNUAL MEET

Ira P. Macnab, Halifax, N.S., was elected president of *The Engineering Institute of Canada* at the group's 65th Annual General and Professional Meeting, held in the Mount Royal Hotel, Montreal, May 9 through 11.

ASME HOLDS SEMI-ANNUAL MEET

Mechanical engineers from every point in the United States gathered at the Royal York Hotel, June 11 through 14, for the 1951 Semi-Annual Meeting of the *American Society of Mechanical Engineers*. More than 80 papers were scheduled for presentation at 38 technical sessions. Also participating were the *American Rocket Society* and the *Institute of Aeronautical Sciences*. *The Engineering Institute of Canada* co-sponsored several social events and sessions.

APHA TO HOLD ANNUAL MEETING

The 79th Annual Meeting of the *American Public Health Association*, the 18th Annual Meeting of its Western Branch, and the annual meetings of 38 related organizations will be held simultaneously in San Francisco, Oct. 29 to Nov. 2, it was announced recently by Dr. Reginald M. Atwater, executive secretary of the Association. The combined meetings will bring together 5000 health specialists from all parts of the Western Hemisphere.

ASHVE IS COOPERATING IN LONDON CONFERENCE

Developments in heat transfer and in the design of related apparatus will be the subjects of discussion at a conference being arranged for September 11 through 13 in London *by The Institution of Mechanical Engineers* and *The American Society of Mechanical Engineers*. THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS is one of the eleven North American Societies cooperating with *The American Society of Mechanical Engineers* in presenting the program. L. P. Saunders, Lockport, N.Y., has been appointed official ASHVE delegate

L. P. Saunders
Lockport, N.Y.

to the conference. Thirty Societies from Britain, the British Commonwealth, and Europe are cooperating with *The Institution of Mechanical Engineers, The Institution of Heating and Ventilating Engineers* being among them.

The two organizing institutions are arranging for the presentation of groups of papers, and it is anticipated that each institution will submit 40 to 50 papers, making a total of 80 to 100 papers for discussion.

The papers will be restricted to developments which have taken place in the last 10 years and five main group headings have been agreed upon as covering the field of discussion. They are: heat transfer with change of state; heat transfer between fluids and surfaces; conduction in solids and fluids; radiation, instrumentation, measurement techniques and analogies; and special problems such as heat transfer in turbine blade cooling, in liquid metals, and in gas turbines.

Summary of Chapter Meetings*

SOUTHWEST TEXAS CHAPTER HONORS DEAN SEELEY AT LUNCHEON

• *SOUTHWEST TEXAS*—April 20, 1951. The meeting was called to order by Pres. I. W. Wilke in the Driskill Hotel, Austin, Tex., and the minutes of the March meeting were read and approved.

Among chapter business covered was a decision to hold the August meeting in Corpus Christi on either August 24 or 31, both of which are Friday nights, thus permitting a vacation weekend for all those who would like to stay over.

In addition, enthusiasm was shown for an all-day engineering meeting or clinic, possibly in October, and President Wilke asked the board of governors and program committee to work together on the promotion of this event.

W. A. Cox, president of the University of Texas Student Branch, brought greetings from his group. He thanked the Southwest Texas Chapter for inviting the student branch to the meeting and for the opportunity to hear L. E. Seeley, president of the Society, and dean, College of Technology, University of New Hampshire, Durham, N. H., who was the evening's guest speaker. Dean Seeley spoke on the subject, *Engineering with the Human Touch*, the address which has provoked much interest in chapters throughout the country.

Before adjournment, a brief report was made on the luncheon given for Dean Seeley and attended by Dean W. R. Woolrich of the University of Texas and other dignitaries. Attendance 55. Attendance ratio 0.46.

• *CENTRAL NEW YORK*—April 25, 1951. Pres. A. L. Jones called the meeting to order at 8:00 p.m. in the University Club, Syracuse, N.Y., and the minutes of the previous meeting and the treasurer's report were read and approved. Officers for the year 1951-52 were unanimously elected as follows: *president*—J. H. Carpenter; *vice president*—F. E. Krell; *secretary*—H. K. Ormsby; *treasurer*—F. D. Putnam; *board of governors*—L. E. LaRow and L. L. Dollinger, Jr. D. L. Mills presented the past president's emblem to retiring President Jones.

W. A. Grant introduced the speaker of the evening, G. V. Parmelee, research associate, ASHVE Research Laboratory, Cleveland, Ohio, who spoke on the subject, *From the Research Laboratory to* THE GUIDE *in Eight Steps*. Mr. Parmelee's talk was followed by a question and answer period. Attendance 48.

• *CENTRAL OHIO*—May 21, 1951. The meeting was called to order by Pres. H. G. Hays at Hoffman's Gardens at 8:00 p.m., and the minutes of the April meeting were read and approved. Mr. Hays, the retiring president, turned the gavel over to the newly elected president, R. S. Curl. After accepting the gavel, President Curl turned the meeting over to R. J. Schmitz, Jr., who introduced

Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

Southwest Texas Chapter honors Dean Lauren E. Seeley, president of ASHVE, at luncheon in Austin, Tex. (*left*) Dean Seeley, Prof. P. Ferguson, Prof. W. E. Long, Dr. F. E. Giesecke. (*right*) Dean W. R. Woolrich, I. W. Wilke, Chancellor J. H. Hart, Dean Seeley, Dr. Giesecke

the speaker of the evening, E. A. Norman, Jr., president of Norman Products Co., Columbus, Ohio. Mr. Norman spoke on the subject, *Dealer Education*, and a discussion followed the talk. Attendance 32. Attendance ratio 0.38.

• *CENTRAL OHIO*—April 16, 1951. R. S. Curl was elected *president*, A. D. Bogen, *vice president*, N. D. Hess, *secretary*, and J. A. Guy, *treasurer*, at the Chapter's regular monthly meeting, held this month at D'Ascanio's.

Following reports by R. J. Schmitz, Jr., R. B. Breneman, and President Curl, a film, *The Eternal Flame*, was shown. Provided by the local gas company, the film was interesting and well received by the members.

Among the business covered prior to the showing of the film was a decision to prepare a letter opposing House Bill No. 618. The bill as presented before the House requires smaller capacity boilers to be operated by licensed engineers.

Pres. H. G. Hays presided. Attendance 28. Attendance ratio 0.24.

• *CONNECTICUT*—May 15, 1951. The meeting was called to order by Pres. A. J. Lawless in the Three Cups Inn, Meriden, Conn., and the treasurer's report and the minutes of the annual meeting were read and approved.

Other business covered included the voting of funds toward the travelling expenses of D. M. Hummel, chapter delegate to the Society's Semi-Annual Meeting in Portland, Ore., July 2 through 4.

President Lawless announced the 1951-52 committee appointments as follows: *membership*—T. L. Arnold, *chairman*; C. J. Wahnquist, Jr.; E. J. Hoagland; J. J. Hull; and J. M. Atherton; *finance*—G. F. Nieske, *chairman*; Peter Fleury; and T. F. Houlihan; *meetings*—C. E. Weisner, *chairman;* W. A. Johnson; P. J. Lamoureux; R. J. Lorenzi; and A. L. Otis; *legislative*—C. W. Freeman, *chairman*; Walter Heywood; and S. R. Osborne; *Connecticut Technical Council*—R. J. Lorenzi and D. M. Hummel; *Chapters Conference Committee member*—D. M. Hummel; and *alternate member*—A. J. Lawless.

Golden Gate Chapter host to Pres. L. E. Seeley. *(l. to r.)* T. J. Janes, vice president of chapter, Dr. B. M. Woods, past president of Society, and President Seeley

The speaker of the evening was Prof. E. R. Queer, Engineering Experiment Station, The Pennsylvania State College, State College, Pa., who spoke on the subject, *The World is Sopping Wet*. Attendance 43.

• *CONNECTICUT*—April 19, 1951. The annual meeting of the Chapter was called to order by Pres. D. M. Hummel at 8:30 p.m. at Diorios Restaurant, Waterbury, Conn., and the treasurer's report and the minutes of the last meeting were read and approved. President Hummel then reported on the Annual Meeting at Philadelphia, after which he thanked his fellow officers and the members of the Chapter for their cooperation and their contribution towards a pleasant and successful year. The teller's committee announced the election of the following officers for the year 1951-52: *president*—A. J. Lawless; *vice president*—T. L. Arnold; *secretary*—R. W. Sidbury; *treasurer*—G. F. Nieske; and *board of governors*—D. M. Hummel, R. J. Lorenzi and W. A. Johnson. Mr. Hummel then presented the gavel to Mr. Lawless, the incoming president.

President Lawless introduced the speakers on the *home talent program* together with their topics as follows: Winfield Roeder—*air;* E. R. Clement, Sr. and Henry Briggs—*steam;* and T. F. Houlihan and R. M. Ripley—*hot water*. Attendance 69. Attendance ratio 0.29.

• *GOLDEN GATE*—May 3, 1951. The meeting was called to order by Pres. R. C. Cushing in the Engineers Club, San Francisco, and the introduction of guests and reading and approval of April minutes followed.

Reports were made by J. E. Murray, treasurer, H. R. Scandrett, chairman of the finance committee, and F. W. Kolb, chairman of the nominating committee. Neil H. Peterson urged Chapter members to attend the Society's Semi-Annual Meeting July 2 through 4. D. H. Gray, Jr., reported on housing and transportation costs and schedules for the benefit of those attending.

L. E. Seeley, president of the Society and dean, College of Technology, University of New Hampshire, Durham, N. H., was the speaker of the evening. His address, *Engineering with the Human Touch*, was interesting and well received. Particularly interesting was his description of the human nasal passages as an extremely efficient heating, cooling, and dehumidifying device. Attendance 52.

• *GOLDEN GATE*—April 15, 1951. Pres. R. C. Cushing presided and called the meeting to order at the Engineers Club, San Francisco.

After the introduction of members and guests and the reading and approval of the March minutes, reports were made by J. E. Murray, treasurer; H. R. Scandrett, chairman, finance committee; E. F. Dill, chairman, membership committee; Eric

Roberts, chairman, attendance committee, and D. E. McLeod, chairman, publicity committee. President Cushing reminded members of the Semi-Annual Meeting in Portland, Ore., July 2 through 4, and requested a large attendance from the Chapter. The feature of the evening was a panel discussion between T. J. White and J. E. Murray on the subject, *Ventilation vs. Heat in the Classroom.* Attendance 97.

• *ILLINOIS*—May 14, 1951. Members and guests met at the M & M Club, Chicago, Ill., and the minutes of the last meeting were read and approved. H. G. Gragg, chairman of the membership committee, announced a total of 41 new members had been obtained for the year. W. A. Kuechenberg, chairman of the legislative committee, gave a report on the activities of the year and suggested that all chapter past presidents serve on this committee as originally suggested by the late John Howatt.

B. L. Casey accepted a Life Membership Certificate from J. W. James on behalf of J. M. Frank, who was hospitalized. President Marschall introduced the chapter past presidents who were in attendance at the meeting, and introduced the incoming chapter president, G. W. Bornquist. President Bornquist then presented the past president's pin to Mr. Marschall.

The speaker of the evening was Lauren E. Seeley, president of the Society, and dean, College of Technology, University of New Hampshire, Durham, N. H. Dean Seeley gave an interesting and informative talk on *Engineering with the Human Touch.* Attendance 117. Attendance ratio 0.27.

• *INDIANA*—March 23, 1951. The meeting was called to order by Pres. C. F. A. Locke in the Construction League Building, Indianapolis.

Following introduction of guests, President Locke announced that the Constitution of the Society had been revised and that all chapters were required to change their by-laws. Consequently, he revealed, the committee for the revision of by-laws was at work to make such changes as were necessary.

President Locke then announced that the Chapter had resigned from the Indianapolis Technical Society, since membership in that Society conflicted with the Society's By-Laws. He said that any members who wish to continue receiving the Technical Society Bulletin may do so by sending the subscription fee to the Technical Society.

The speaker of the evening was D. L. Mills, research and development engineer, Revere Copper and Brass Inc., Rome, N.Y., who gave an interesting address on radiant panel heating applications. Mr. Mills is a past president of the Western New York Chapter. Attendance 32.

• *IOWA*—May 8, 1951. After Pres. R. S. Stover called the meeting to order at 7:30 p.m. in the Standard Club, the roll of members was taken and the guests were introduced. President Stover then appointed the tellers of election, who, after counting the ballots, announced the results as follows: *president*—C. H. McGuiness; *vice president*—R. H. Schnell; *secretary-treasurer*—J. F. Sandfort; *board of governors*—D. E. Schroeder and B. A. Schwirtz. Mr. Stover presented President McGuiness with the gavel of the office of president.

President McGuiness introduced the speaker of the evening, Ernest Szekely, first vice president of the Society and president, Bayley Blower Co., Milwaukee, Wis., who spoke on *Fans—Their Design and Application.* He opened his talk with a review of the purposes of fans, kinds of fans and classifications as to materials used in their manufacture. His talk was accompanied by slides showing empirical data on various types of fans and characteristic curves illustrating the operating performance under varying conditions. Mr. Szekely also discussed the history of fan development and the changes in design. The talk was well received by the members and guests. Attendance 36.

• *IOWA*—April 17, 1951. Pres. R. S. Stover called the meeting to order in the Standard Club and the minutes of the March 13 meeting were read and approved. Perry LaRue gave a report of the nominating committee's recommendations for 1951-52 officers.

The guest speaker of the evening was Mr. Wales, Providence, R. I. representative of the *Institute of Boiler and Radiator Manufacturers.*

Group shown at charter meeting of Kansas Chapter, held March 6th, in Walnut Room of Hotel Lassen, Wichita, Kan., at which Dean Lauren E. Seeley presented the charter to Pres. R. F. Bauer

Mr. Wales pointed out the reasons for the development of I=B=R, citing the need for contractors to use a scientific approach in figuring and laying out heating systems, rather than the rule-of-thumb method. He then outlined the subjects covered by the course and the methods employed to teach the various subjects.

This was followed by a discussion of the use of the research house at the University of Illinois for obtaining operation data. The question of fuel saving by night thermostat set-back, the trend toward pipe size reduction, test results on the use of baseboard radiation, and the use of baseboard radiation at the ceilings of bathrooms all were discussed. Attendance 34.

• *KANSAS CITY*—May 7, 1951. Pres. W. E. Howarth called the meeting to order at 7:35 p.m. in the Wishbone Restaurant, Kansas City, Mo., and members and guests introduced themselves. The minutes of the April meeting and the treasurer's report were approved. Professor Snyder of the University of Kansas announced that the first annual meeting of the Diesel Operators Institute was to be held May 17 through 19 at Lawrence, Kan.

The following were elected as the new officers for the coming year: *president*—C. W. Schumacher; *vice president*—W. A. Reichow; *secretary*—G. H. Stoffer; *treasurer*—J. G. Barnes, Jr.; and *board of governors*—W. E. Howarth, Carl Clegg and R. B. Mason. F. K. Ladewig was given a vote of thanks for the amount of time and effort that he spent in getting out the Btu Breeze. Past President Howarth expressed his appreciation for the help that he had received in the last year from the various committees and then introduced the new officers. The first official action taken by the new president, Mr. Schumacher, was the re-appointment of Mr. Ladewig as chairman of the Newsletter Committee for next year.

The speaker of the evening was Charles R. Neeson, refrigeration consultant, Airtemp Division, Chrysler Corp., who spoke on *High Speed Variable Capacity Compressors*. Among the high points of the address was the part which dealt with the great strides made in increasing compressor speeds and reducing compressor sizes in the period from 1910 to the present. The main advantage of the high speed compressor, he pointed out, is that it can be made sufficiently small and light to be included in packaged units. An interesting question and answer period followed the talk. Attendance 103. Attendance ratio 0.36.

• *MEMPHIS*—May 21, 1951. The meeting was called to order by Pres. R. E. Larkin in the King Cotton Hotel and after the guests were introduced, the minutes of the last meeting were read and approved.

Reports were made by N. C. Ledbetter, picnic committee, who reported that two locations were being considered for the annual picnic, and by President Larkin who revealed that a board of directors meeting would be called soon. He concluded by requesting members to attend the Semi-Annual Meeting of the Society in Portland, Ore., July 2 through 4.

The speaker of the evening was L. L. Arbuckle, chief engineer, Refrigeration Division, Bell & Gossett Co., Morton Grove, Ill. Mr. Arbuckle discussed water chilling equipment, and, with the aid of slides, touched upon some of the advances made in this field. Attendance 20. Attendance ratio 0.25.

• *MEMPHIS*—April 16, 1951. Pres. C. S. Fischer, the presiding officer, called the meeting to order at 6:30 p.m. in the King Cotton Hotel, and, following dinner, guests were introduced and welcomed by President Fischer. The minutes of the previous meeting were read and approved and the tellers of election were instructed to count the ballots and withhold the results until later.

The program consisted of a panel discussion on *Panel Heating*, with President Fischer acting as moderator. Panel members included: E. E. Scott, W. L. Wellford, Jr., and H. H. Wilson, all chapter members, and George Leeper, one of the guests. Some timely and informative questions were discussed and the audience displayed great interest.

The following were elected as the new officers for the coming year: *president*—R. E. Larkin; *vice president*—G. C. Burr; *secretary*—A. T. Bevil; and *treasurer*—H. H. Wilson. N. C. Ledbetter was chosen as the new three-year member on the board of governors. Past President Fischer thanked the members for their cooperation and support during the past year. Attendance 55. Attendance ratio 0.58.

• *MINNESOTA*—May 7, 1951. Pres. G. M. Kendrick called the meeting to order in the Garden Room of the Dyckman Hotel, Minneapolis, and the introduction of guests and reading and approval of the April meeting minutes followed.

President Kendrick then discussed the second draft of new chapter bylaws, urged members to attend the Semi-Annual Meeting in Portland, July 2 through 4, and announced that C. G. Burritt had been presented with a Life Membership Certificate in the Society.

Following this, 1951-52 officers were installed, Past Pres. R. C. Jordan officiating at the installation.

President Elect E. F. Snyder, Jr., introduced the speaker, F. J. Nunlist, Jr., chief engineer, L. J. Mueller Furnace Co., Milwaukee, Wis., who presented an interesting address on warm air perimeter heating and new developments in gravity warm air heating. Attendance 108. Attendance ratio 0.35.

• *MONTREAL*—April 16, 1951. The meeting was held at the Berkeley Hotel, and was called to order at 6:30 p.m. by Pres. R. R. Noyes. The minutes of the March meeting were read and approved, and the treasurer reported that the chapter's financial status was good. The annual report was then presented by retiring President Noyes, and then the new officers were installed by Leo Garneau. The new officers are as follows: *president*—J. G. Chenevert;

vice president—W. J. Hole; *secretary*—B. J. Horsburgh; *treasurer*—D. L. Lindsay; and *board of governors*—R. R. Noyes, R. J. Ker, J. C. Hennessey, J. G. Lefrancois, and R. A. Standring.

J. J. Cooper introduced the speaker of the evening, G. N. Martin, combustion sales engineer, Dominion Bridge Co., Ltd., Montreal, who spoke on *Economics of Heating Boiler Selection*. Attendance 51.

• *NEW YORK*—May 21, 1951. A presentation by J. S. Locke, sales manager, Commercial Division, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., on the subject, *Electronic Control of Heating and Air Conditioning*, was featured at the regular monthly meeting of the Chapter in the Building Trades Club, New York, N.Y.

With the aid of slides, Mr. Locke traced the development of thermostatic controls from the simple bimetal thermostats, which operated at temperature differentials of three degrees, to present electronic thermostats, which can easily function at one-tenth degree differential.

Because the electronic tube acts as an amplifier, it was found to provide great sensitivity when used in thermostatic, pressure, and humidity controls, the presentation disclosed, and consequently opened up an entirely new field.

Development is going on in the industrial as well as domestic field, Mr. Locke said in closing, many of the present applications being in the transportation field, including railway cars, passenger planes, and military aircraft.

Business covered before Mr. Locke's address included the presentation of a plaque to retiring Pres. Carl F. Kayan. President Kayan then introduced the officers for 1951-52. They are: *president*—Ernst Graber; *vice president*—P. B. Gordon; *secretary*—Carl H. Flink; *treasurer*—W. M. Heebner. Membership chairman C. S. Koehler introduced four new members. They are: J. N. Fink, H. E. Friedrich, D. R. Newcomb, and B. M. Natkin. Attendance 120. Attendance ratio 0.15.

• *NEW YORK*—April 16, 1951. The meeting was called to order at 8:00 p.m. following a social hour and dinner, in the Building Trades Club, New York, N.Y. The minutes of the March 19 meeting were read and approved, and membership chairman C. S. Koehler presented the name of a new member, A. E. Burns. Reports were given by the treasurer and the secretary, and F. A. Fideli reported the results of the election of officers as follows: *president*—Ernest Graber; *vice president*—P. B. Gordon; *secretary*—Carl H. Flink; *treasurer*—W. M. Heebner; and *board of governors*—J. B. Hewett, Carl F. Kayan, J. E. Schechter, R. L. Stinard, and Clifford Strock.

J. B. Hewett, program chairman, introduced the speaker of the evening, F. K. Green, Air Research Associates, New York, N. Y., who spoke on the subject, *Problems in Modernizing Existing Large Buildings by Air Conditioning*. Mr. Green stated that air conditioning would increase rental value in New York by $1.75 to $2.00 per sq ft per year and was therefore a good investment. This advantage brought about the demand for air conditioning of old buildings and in many cases required the installation of the equipment without interrupting the normal business going on at the same time. He described operations in air conditioning a 20-story building in New York City. An arrangement was made to use an old smoke stack for a downfeed duct from the air conditioning equipment on the roof. Another new duct was also required. Both ducts carried air at 5,000 fpm to the different floors where velocity was reduced through sound traps to low velocity before distribution to the rooms. Attendance 130. Attendance ratio 0.21.

• *NORTHEASTERN OKLAHOMA*—May 8, 1951. The meeting was called to order by Pres. R. F. Shoemaker in the Hotel Alvin and the minutes of the previous meeting were read and approved.

The evening featured a panel discussion on the most effective use of insulation, fenestration, and temperature regulation in achieving indoor climate control.

Covering the three major phases of the subject were: F. C. Brandt, Minneapolis-Honeywell Regulator Co., who talked on controls; S. E. Bosley, Owens-Corning Fiberglas Co., who spoke on insulation; and H. A. Schofield, Libbey Owens Ford Glass Co., who discussed glass, with particular emphasis on the insulating type. Each address was reinforced with slides. Attendance 54. Attendance ratio 0.58.

• *NORTHERN OHIO*—May 14, 1951. Pres. W. M. Rowe called the meeting to order in the Warner Auditorium, and the minutes of the April meeting were read and approved. A special feature of the meeting was the introduction of 11 past presidents of the Chapter, namely: M. L. Crowell, F. H. Valentine, C. F. Eveleth, G. L. Tuve, Lester T. Avery, J. P. Jones, H. E. Wetzell, P. D. Gayman, D. L. Taze, W. R. Moore, and R. L. Byers, each of whom made a few remarks at the dinner preceding the meeting.

President Rowe called on the chairmen of the various committees to make reports and paid special tribute to L. C. Burkes, program chairman, for his skill in arranging well balanced programs during the past year. It was announced that the Spring Golf Party would be held at Columbia Hills on June 15 and everyone was urged to attend.

R. L. Byers announced the slate of officers nominated for 1951-52, and the nominees were unanimously elected as follows: *president*—John Richmond; *vice president*—R. E. Sherman; *secretary*—R. G. Huebscher; *treasurer*—L. C. Burkes; and *board of governors*—W. M. Rowe, J. M. Black, and D. E. Mannen, Jr. Past President Avery then presented D. E. Humphreys with a Life Membership Certificate in the Society and also one from the Northern Ohio Chapter.

Mr. Burkes then introduced Willson Hunter of the staff of the Chief of Research of the National Advisory Committee for Aeronautics Flight Propulsion Laboratory. Mr. Hunter described the power plant research being carried on and emphasized the

work that was being done to develop turbo-jet and ram-jet engines. He illustrated the facilities with slides, and discussed the problems of air handling, cooling and drying. The meeting closed with the showing of a color film on the activities of the *NACA* throughout the country. Attendance 56. Attendance ratio 0.20.

• *NORTHERN OHIO*—April 8, 1951. The meeting, a joint one with the Cleveland Chapter of *ASRE*, was called to order in the Warner Auditorium. Following reading and approval of March meeting minutes, reports were given by J. N. Sampson, membership committee, C. R. Matthews, entertainment committee, and L. C. Burkes, program committee.

The speaker addressing the joint session was E. L. Schultz, district branch manager, Carrier Corp., Pittsburgh, Pa., who spoke on *High Velocity Air Conditioning*. Such units, he pointed out, were being used as much as ten years ago, saving space and reducing the number of units required. The need for greater fan power and increased refrigeration comprised the principal limitations, he said. Slides of typical installations were shown and the meeting was concluded with a lively discussion. Attendance 120. Attendance ratio 0.21.

• *OKLAHOMA*—May 14, 1951. After calling the meeting to order at 8:00 p.m. in Beverly's Drive-In, Oklahoma City, Okla., Pres. R. E. Swan announced the election of the officers for 1951-52 as follows: *president*—J. H. Carnahan; *vice president*—S. J. White; *secretary*—W. J. Collins, Jr.; *treasurer*—F. X. Loeffler, Jr.; and *board of governors*—J. H. Spaan, Jr., H. S. Shafer, and R. E. Swan.

The speaker of the evening was M. G. Munson, technical adviser, Unit Ventilator Division, Herman Nelson Division of American Air Filter Co., Inc., Moline, Ill. Mr. Munson spoke on *Present Day Problems of Classroom Heating and Ventilating*. He opened his address by explaining the chemical and thermal theories regarding adequate ventilation and stated that the thermal theory was the governing factor as far as the practical application was concerned. He explained that in classrooms the intermittent operation, occupancy, solar heat gain, and outside temperature are the principal factors to be considered in designing a heating and ventilating system. He further explained that cooling is often required with the ventilation and told why the cooling was necessary and how it could be accomplished. Mr. Munson then described briefly the advantages and disadvantages of the four principal types of heating and ventilating systems applicable to classrooms: (1) radiant panels with open windows; (2) direct radiation and open windows; (3) a central blast system; and (4) the unit ventilator system. Attendance 46. Attendance ratio 0.44.

• *ONTARIO*—May 16, 1951. Announcement of William Philip as *president;* J. H. Ross, *vice president;* H. R. Roth, *secretary-treasurer;* and N. W. Kingsland, M. C. Bailey, and D. L. Angus, *board of governors*, was made by the retiring president.

In a ceremony held soon after the opening of the meeting, President Ross presented retiring Pres. J. H. Fox with a certificate from the officers and members of the Chapter in recognition of his services. In the near future, Mr. Fox will also receive an emblem.

Reports were made by J. H. Ross, J. W. Darling, G. S. McKernan, M. C. Bailey, C. J. Bootes, N. W. Kingsland, William Philip, F. W. Chambers, C. D. Waldon, F. G. Ewens, and Charles Torry.

The meeting was highlighted by two addresses. The first was by O. W. Ellis, Ontario Research Foundation, who spoke on the subject, *Research in Engineering*. The second was by Cyril Tasker, director of research, ASHVE Research Laboratory, Cleveland, Ohio, who spoke on research work being conducted by the Society, and also on the possibility of some research work being done in Canada. Attendance 116.

• *OREGON*—May 7, 1951. Pres. H. W. McKenzie called the meeting to order at 7:29 p.m. in the Georgian Room of the Old Heathman Hotel, and the minutes of the previous meeting were read and approved. Dick Blankenship, membership chairman, welcomed two new members into the Chapter: L. F. Miller and G. R. Folds, Jr. President McKenzie called on B. W. Farnes, general chairman of the Committee on Arrangements, to give a report on the progress of plans for the Semi-Annual Meeting.

After a brief recess, J. D. Kroeker introduced the speaker of the evening, L. E. Seeley, president of the Society and dean, College of Technology, University of New Hampshire, Durham, N. H., who spoke on *Engineering with the Human Touch*. Dean Seeley pointed out that the heating and ventilating branch of engineering is vitally concerned with the health, welfare and comfort of individuals and, because of this, the human reaction to our efforts in behalf of the public is of importance to us. Dean Seeley's address was received with a great deal of interest. Attendance 75. Attendance ratio 0.45.

• *PITTSBURGH*—May 14, 1951. W. D. Simpson was elected *president;* B. B. Reilly, *vice president;* E. H. Riesmeyer, Jr., *secretary;* C. L. Benn, *treasurer;* and A. F. Metzger, H. A. Biber, and O. L. Williams, *board of governors*.

Retiring President Metzger's final official acts prior to turning over the gavel and being honored with a past president's pin included a report on the Engineer's Meeting, April 19 and 20, a request that members attend the Semi-Annual Meeting in Portland, July 2 through 4, and announcement of the auditing committee for the year, as follows: G. S. Peacock, chairman; F. J. Naughton, and G. W. Cost.

A social program was featured for the remainder of the evening. Attendance 54. Attendance Ratio 0.29.

• *ST. LOUIS*—April 10, 1951. Pres. J. S. Rosebrough presided and called the meeting to order in the Forest

Park Hotel. Reading and approval of March meeting minutes followed.

J. B. Killebrew, chairman, membership committee, revealed that two new members had been enrolled and several requests for application blanks had been received; C. H. Burnap, who announced the date of the next meeting; and J. H. Carter, who spoke about a bill now pending in the Missouri Legislature that would affect engineers and the engineering profession. The meeting was then turned over to L. L. Hamig, partner, Ferris & Hamig, consulting Engineers, St. Louis, who spoke on the subject, *Blow-Through Air Conditioning Unit.* Attendance 57.

• *SHREVEPORT*—May 17, 1951. The meeting was called to order by Pres. S. W. Beaty and the introduction of guests followed. Among them was Reg F. Taylor, second vice president of the Society, who gave a short talk. Other guests were: Major Leonard Parsons, Jack Annan, Bill Gilmer, Frank Taylor, Randy Nichols, J. J. Rebouche, and G. J. Wilson.

The guest speaker of the evening was A. E. Vroome, mechanical engineer, Ebasco Services, Inc., New York, N. Y., who spoke on the subject, *Some Practical Aspects of Dehumidification, Lighting Loads, Turbine Driven Compressors, and Room Conditioners for Office Buildings in the Southwest.*

• *SHREVEPORT*—April 19, 1951. The meeting was called to order by Pres. S. W. Beaty, and the minutes of the previous meeting were read and approved. The guest speaker of the evening was L. E. Seeley, president of the Society, and dean, College of Technology, University of New Hampshire, Durham, N. H., who spoke on the subject, *Engineering with the Human Touch.*

• *SOUTH TEXAS*—May 18, 1951. Election of officers and past president's night highlighted the Chapter's regular monthly meeting in the Alabama Cafeteria. Officers elected for 1951-52 are: *president*—G. J. Collins;

Shreveport Chapter Officers greet Dean Lauren E. Seeley as he arrives to address April meeting

vice president—C. L. Fleming; *secretary*—E. G. Floeter, Jr.; *treasurer*—J. W. Holland; and *board of governors*—F. M. Neil and J. C. Lewis. Following the election, the new president asked all past presidents to rise and then presented retiring president, H. W. Broadwell, with his past president's pin.

Mr. Holland, program chairman, conducted a panel discussion on the subject, *Ideas for Cooperation which would Produce a Better Job.* Members participating were: R. J. Salinger, Ben Beard, A. F. Leonard, C. C. Quin, and D. S. Freese. The discussion proved so interesting that it could have lasted hours longer, Secretary C. L. Fleming reported.

Prior to the election, reports were given by: Reg F. Taylor, D. M. Robinson, auditing committee, J. C. Lewis, chairman, membership committee, J. N. Powell, chairman, attendance committee, and G. J. Collins, representative, Engineers Council. Attendance 71. Attendance ratio 0.35.

• *SOUTH TEXAS*—April 20, 1951. The meeting was called to order by Pres. H. W. Broadwell in the Alabama Cafeteria and the following guests were introduced: Dr. E. E. Oberholtzer, president, University of Houston, and Mrs. Oberholtzer; Dr. Engley, University of Texas Medical School; and Dr. C. A. Nau, Medical School of Galveston.

Reports were then made by E. G. Floeter, Jr., treasurer; J. C. Lewis, chairman, membership committee; and J. Wayne Holland, chairman, program committee.

Following these reports, the meeting was turned over to the guest speaker, L. E. Seeley, president of the Society, and dean, College of Technology, University of New Hampshire, Durham, N. H., who spoke on the subject, *Engineering with the Human Touch.* Attendance 80. Attendance ratio 0.43.

• *SOUTHERN CALIFORNIA*—May 16, 1951. M. C. Greiner was elected *president;* J. S. Earhart, *vice president;* L. B. Davenport, *secretary;* C. D. Walz, *treasurer;* and L. J. Helms, J. L. McCullough, Stuart Giles, T. H. Creears, and Leo Hungerford, *board of governors,* at the Chapter's regular monthly meeting in the Carolina Pines Restaurant.

Since the election of officers comprised the only business of the evening, the meeting was immediately turned over to the speaker, J. W. May, technical director, Air Filter Division, American Air Filter Co., Louisville, Ky., who spoke on the subject, *Trends and Recent Developments in Air Filtration.* Mr. May, who has had wide experience in the

field, first presented the history of the development of air-dust filters as applied to ventilating and air conditioning systems since about 1880. He then made comparison between the three fundamental types of filter media in their several variations and arrangements with reference to their respective adaptabilities to specific problems and their relative maintenance. In conclusion, Mr. May said that he felt the air filter industry was making progress in improving cleaning efficiency and reducing maintenance requirements. Retiring President L. J. Helms presided. Attendance 87. Attendance ratio 0.39.

• *WASHINGTON, D.C.*—May 2, 1951. The Washington, D.C. Chapter, in cooperation with the Engineers Club of Washington, D.C., held its Annual Ladies Night Meeting at the Bethesda Country Club, Bethesda, Md. A buffet supper was served at 8:00 p.m., and a four piece orchestra played every kind of dance number from old fashioned waltzes to snappy fox trots and rhumbas, and a very colorful Mexican Hat dance in which everyone joined. Those who tired of dancing either watched television or strolled around the beautiful grounds. According to the Secretary's report, the weather was ideal and everyone agreed that it was one of the most successful Ladies Night events the Chapter had ever had. Attendance 150.

• *WESTERN NEW YORK*—May 14, 1951. Sixteen past presidents of the Chapter were on hand as the group marked Past President's Night at its regular monthly meeting in the University Club, Buffalo. Past presidents in attendance were: G. E. Adema, M. C. Beman, J. H. Bryce, Joseph Davis, Roswell Farnham, L. A. Harding, W. R. Heath, M. S. Jackson, D. J. Mahoney, F. A. Moesel, S. M. Quackenbush, L. P. Saunders, W. E. Voisinet, F. J. Weber, Edwin Woolcock, and J. H. Yager.

Another high point of the meeting was the announcement of officers for 1951-52. They are: T. F. Killeen—*president;* J. M. Quackenbush—*first vice president;* C. W. Stone—*second vice president;* R. E. Lang—*secretary;* B. C. Candee—*treasurer;* and C. W. Kaupp—*assistant treasurer.*

The speaker of the evening was E. Holt Gurney, president, The Gurney Foundry Co., Toronto, Ont., and a past president of the Society. He was introduced by Mr. Harding, who is also a past president of the Society and first president of the Western New York Chapter. Mr. Gurney gave an interesting talk on his recent trip through Europe. Particularly interesting was the phase which dealt with heating in England. Attendance 35.

• *WISCONSIN*—May 15, 1951. Following a social hour and dinner, Pres. F. J. Nunlist called the meeting to order at 8:10 p.m. at the Engineering Society Building, Milwaukee, Wis.

The election of the following officers for the year *1951-52* was then announced: *president*—H. F. Brinen; *vice president*—J. A. Lofte; *secretary*—L. C. Plaehn; *treasurer*—N. E. Hill; and *board of governors*—D. W. Nelson, C. H. Randolph, and F. J. Nunlist. Retiring President Nunlist then turned over the presidential duties to Mr. Brinen with the presentation of an engraved gavel and his best wishes.

Prof. G. L. Larson introduced the speaker of the evening, L. E. Seeley, president of the Society, and dean, College of Technology, University of New Hampshire, Durham, N.H., who spoke on *Engineering with the Human Touch.* After an interesting discussion period following the talk, the meeting was adjourned by President Brinen with a vote of appreciation to Dean Seeley. Attendance 63. Attendance ratio 0.25.

• *WISCONSIN*—April 23, 1951. The meeting was held in the Capitol Hotel, Madison, Wis., and Pres. F. J. Nunlist opened the meeting with a welcome to members and guests. The minutes of the March meeting were read and approved, and L. C. Plaehn, membership chairman, announced that G. R. Flaherty of McDonnell & Miller, Inc., had been accepted into the Chapter. The nominating committee report was presented and Prof. D. W. Nelson invited the members and guests to the Engineers Memorial Day, May 4, at the University of Wisconsin.

Professor Nelson then introduced the speaker of the evening, C. E. Dutton, district supervisor, Mineral Deposits Branch, U. S. Department of Interior, who spoke on *Mineral Supplies of the Steel Industry.* Mr. Dutton gave a most informative talk on the geology of the earth, explaining that the earth consists essentially of rocks made from sand, clay, or lime. He gave the reasons why certain rock are found in specific localities. After a discussion period, the

Past Presidents of Western New York Chapter and guest speaker, E. Holt Gurney. (*l. to r.*) *Seated:* W. E. Voisinet, D. J. Mahoney, L. A. Harding, Joseph Davis, Roswell Farnham. *Standing:* W. R. Heath, F. J. Weber, L. P. Saunders, Edwin Woolcock, Mr. Gurney, J. H. Bryce, G. E. Adema, F. A. Moesel, J. J. Yager, M. S. Jackson

meeting was adjourned with a vote of thanks to Mr. Dutton for his presentation of the subject. Attendance 47. Attendance ratio 0.25.

STUDENT BRANCHES

• *OKLAHOMA A. & M. COLLEGE*—May 17, 1951. Pres. R. F. Mossman called the meeting to order at 7:00 p.m. and the minutes of the previous meeting were read and approved. After a few reports were given, President Mossman read a letter from Professor Venn, head of the Mechanical Engineering Department, congratulating the Student Branch for its part in helping the Mechanical Engineering section to win the Exposition trophy.

The election of officers for the 1951 fall semester was held with the following results: *president*—O. A. Brynie; *vice president*—P. L. Ground; *secretary*—D. W. Ray; *treasurer*—V. O. Wagner, Jr., *student council representative*—R. D. Robertson. Attendance 13. Attendance ratio 0.82.

Attention!!
Members of ASHVE
Moved or Moving?

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• *OKLAHOMA A. & M. COLLEGE*—April 19, 1951. The meeting was called to order by Pres. R. F. Mossman and the reading and approval of minutes of the previous meeting followed. Three guests were then introduced. They were: R. E. Swan, president, Hirsch-Swan Corp., Oklahoma City, Okla.; W. H. Orr, a graduate of Oklahoma A. & M. now connected with the Hirsch-Swan Corp.; and Mr. Mehl, Carrier Corp., Dallas, Tex., who was the guest speaker of the evening. He gave an interesting talk on the problems encountered in air conditioning of tall buildings. Mr. Swan then showed a film on the manufacture of several types of air conditioning units manufactured by his company. Attendance 17. Attendance ratio 0.82.

• *PURDUE UNIVERSITY*—April 23, 1951. Chairman Stanley Kalfus called the meeting to order in room 108 of the Mechanical Engineering Building, and officers for the coming semester were elected to replace the graduating members. The following were elected: *chairman*—N. J. Kirch; *vice chairman*—R. O. Bement; *secretary*—T. L. Burcham; *coordinator*—A. M. Landerman; *reporter*—Melvin Kalfus.

The meeting was turned over to Prof. W. T. Miller, who presided over the panel discussion on what industry expects of a graduating engineering student. Four different phases of engineering work were represented by the members of the panel. Attendance 59. Attendance ratio 1.00.

Candidates for Membership

The Society's By-Laws require that all applications for membership or advancement are to be sent to the Executive Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society, or mailed to all members. When the replies are received from references the Candidate's application shall be submitted to and acted upon by the Admission and Advancement Committee as soon as possible.

When the Admission and Advancement Committee has acted favorably upon a Candidate's application and assigned his grade, the Council shall confirm the election of the proposed Candidate for membership. During the past month 53 applications for membership, including 6 student applications, 2 reinstatements; and 10 advancements have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Admission and Advancement Committee, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Executive Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by July 30, 1951, these candidates will be voted upon by the Council. Those elected to membership will be notified by the Executive Secretary immediately after election.

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Sorbents: G. L. Simpson, *Chairman;* G. C. F. Asker, P. C. Dehler, John Everetts, Jr.*, S. Gates, Jr., E. W. Gilford, H. W. Heisterkamp, E. R. McLaughlin, J. C. Patterson, F. J. Sweney.

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● **UNIVERSITY OF TEXAS:** Organized 1949. Headquarters, Austin, Tex. Meets, First and Third Tuesday. PRESIDENT, W. A. Cox, 360-D Deep Eddy Apts., Austin. SECRETARY, V. H. Miles, PHP Dorm J, Austin.

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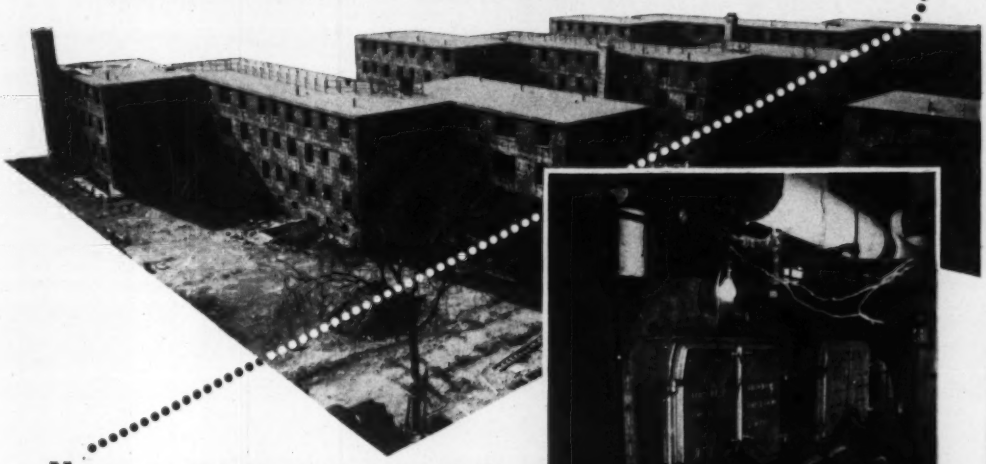
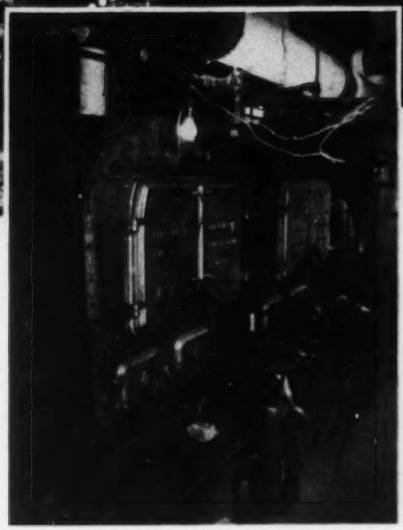
This housing project

WILL HAVE ECONOMICAL HEAT





Above, the boiler room of Codding Court Housing Project, with workmen putting in final touches on the installation of the Fitzgibbons boilers.

Nearing completion in the photo above is the Providence (R. I.) Housing Authority's Codding Court Project. The entire project is centrally heated by two Fitzgibbons 12,100 sq. ft. "D" Type boilers, oil fired. Just another of the many similar projects in population centers everywhere, holding operating costs down by applying the fuel savings of Fitzgibbons steel boilers. Write for Bulletin HP-6.

Architects and Engineers, Creer, Kent, Mather, Cruise & Aldrich, of Providence. General Contractors, The Gilbane Building Co., Providence. Heating Contractor, Joseph P. Cuddigan, Providence.

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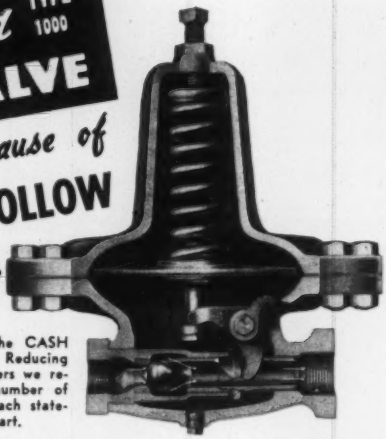

Below is shown 10 benefits obtainable with the CASH STANDARD Type "1000" Streamlined Pressure Reducing Valve. Statements from a few of the many letters we receive from users are listed. Each gives the number of benefits realized. Check the letter preceding each statement against the corresponding letters in the chart.

A A Maintenance Engineer checks 7 of the points and says, "We have experienced excellent results."

B A Tire Company in checking 10 points says, "We wouldn't hesitate a minute in recommending the '1000'."

C A Maintenance Engineer checks 10 of the points and says, "We use the '1000' under very adverse conditions and find it perfect in every way."

D A Mill Supply Company checks 6 of the points and says, "Said valves can be throttled to practically zero from pressure set at."

E A Manufacturer checks 7 of the points and says, "We have found the '1000' to be a very good pressure controller in every way."

F A Maintenance Engineer checks 8 of the points and says, "If we had more places to use Type '1000' I would insist on using them."

A B C D E	**POINT No. 1** Maximum capacity when needed most.
A B C D E F	**POINT No. 2** Accurate pressure control under toughest working conditions.
A B C E F	**POINT No. 3** Trouble-free service.
A B C D E F	**POINT No. 4** Smooth operation.
B C E F	**POINT No. 5** Tight closure.
B C D E F	**POINT No. 6** Speedier production results.
A B C E F	**POINT No. 7** Elimination of failures.
B C D F	**POINT No. 8** Cost-saving operation.
A B C F	**POINT No. 9** No spoilage.
A B C D E F	**POINT No. 10** Practically zero in maintenance.

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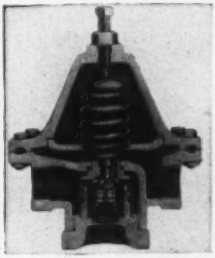
Send for them



Bulletin 950—features the CASH STANDARD Type D Single Seat Pressure Reducing and Regulating Valves for use with most fluids. Shows simple inner working parts that save in maintenance. Diagram explains how valve works. Blueprint shows simplicity of installation.

Bulletin 956—features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.

Bulletin 966—features the CASH STANDARD Self-Contained, Pilot Operated Type 10 Pressure Reducing and Regulating Valve for use with water or air; with any gas or oil that is non-corrosive; and with refrigerating fluids such as Ammonia and Freon. Many interesting particulars explained such as: how valve works, tight seating, large capacity, no waste, no water hammer or chatter.

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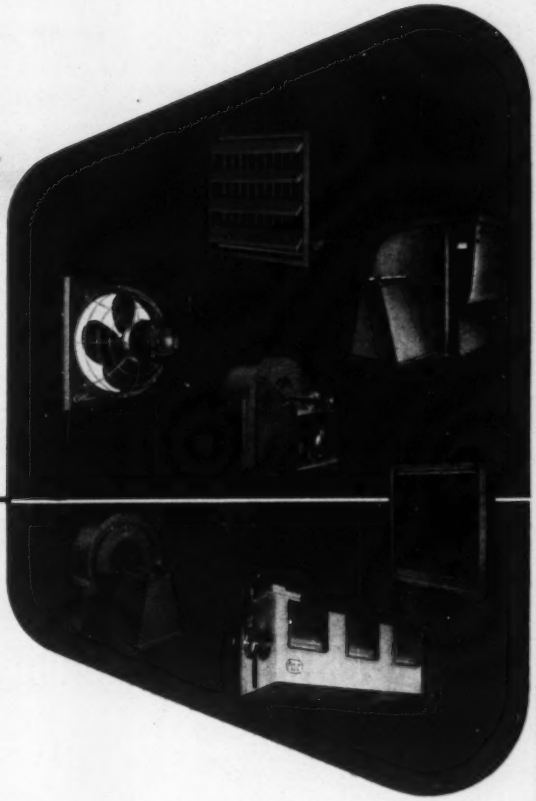

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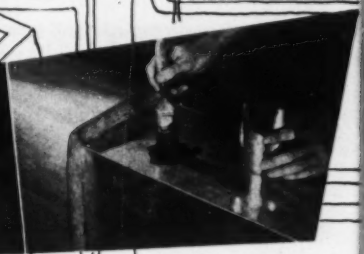

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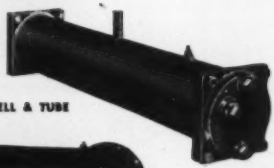
Compact
Dual Pass (J300 & larger)

SHELL & COIL



SHELL & TUBE

AMMONIA CONDENSERS

Exclusive Locknut Construction Available Rolled-in or Welded Tubes
A.S.M.E. Construction and Certification
Locknut Assembly for Easy Replacement
Custom Built

AMMONIA

These are only a few of the features and advantages that have made ACME Condensers the choice of the heavy refrigeration Industry for quality, design and lasting performance. Write for catalog on equipment you require.

ACME ALSO MANUFACTURES:

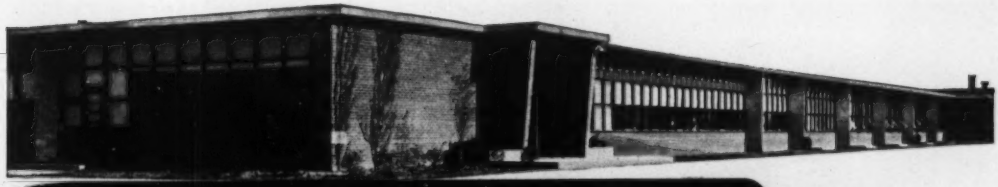
Dry-Ex* Water Coolers • Hi-Peak* Water Coolers • Flow-Cold* Liquid Chillers • Fin Coils • Cooling Towers • Oil Separators • Liquid Receivers • Heat Exchangers • Bio-Cold* Industrial Unit Coolers • Flow-Cold Refrigeration Units • Convectors

* Trade Mark

ACME INDUSTRIES, INC.
Dept. HP
Jackson, Michigan

ACME PRODUCTS

continuously serving the refrigeration industry since 1919



HERE'S *HOW* AN ARCHITECT BUILT A SCHOOL AROUND THE HEATING AND VENTILATING SYSTEM AND SAVED *30%* ON SYSTEM INSTALLATION

Listed by Underwriters' Laboratories

Approved by American Gas Association

Dravo "COUNTERFLO" Heaters operate automatically, provide constant-temperature fresh air to Hillsborough School.

When the Hillsborough, New Jersey, School was built, architect Jay C. VanNuys specified Dravo "Counterflo" Heaters and built the school *around* the heating and ventilating system, rather than trying to "fit" the system to the school.

Two direct-fired "Counterflo" Heaters, with an output of 1,750,000 Btu per hour each, heat 20,000 cu. ft./min. of fresh filtered air for the 21 rooms of the new school building during the winter months. In warm weather, these same heaters provide comfortable ventilation for the entire school.

The heating and ventilating system is thermostatically controlled and automatic in operation. The unique construction of the school eliminated the need for duct work.

THE RESULTS? The Dravo heater installation at 81¢ per sq. ft. cost 30% less than would a conventional "wet" system; heating and ventilating represented 7% of the total building cost.

Versatile Dravo Heaters can solve many school heating problems.

Dravo "Counterflo" Space Heaters are ideal for heating and ventilating such school facilities as . . . gymnasiums . . . auditoriums . . . stadium rooms . . . libraries . . . cafeterias . . . book stores . . . locker rooms . . . field houses . . . school garages . . . indoor swimming pools . . . manual training shops . . . laundries . . . classrooms.

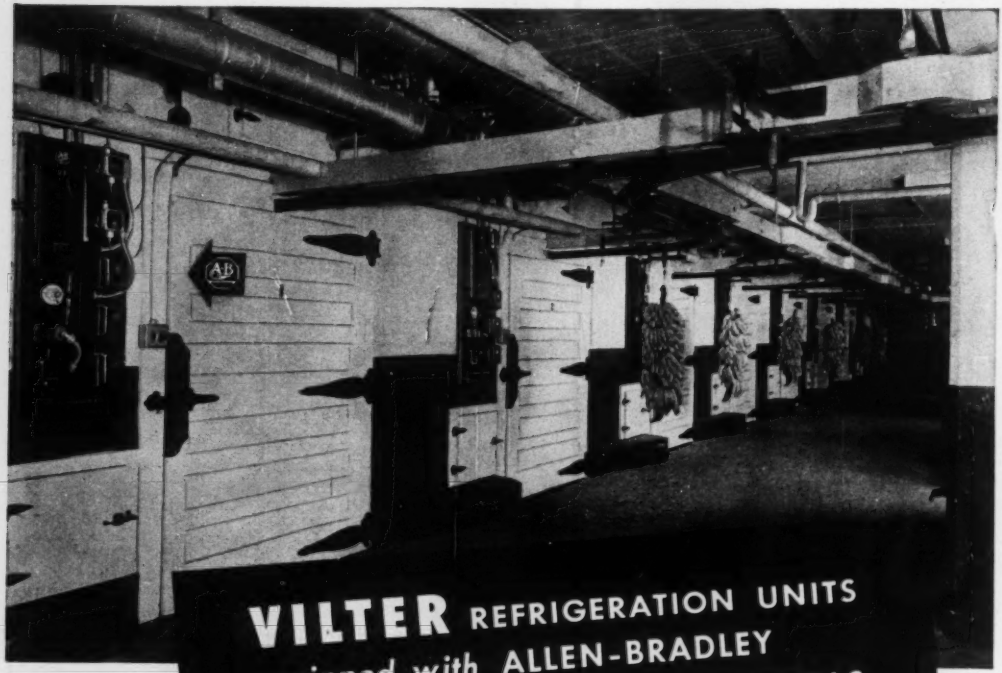
DRAVO HEATERS OFFER YOU—

- **Low initial cost . . . users report 50% to 60% savings.**
- **Concentration of heat at working level.**
- **Low Fuel consumption . . . burn gas or oil . . . easily converted.**
- **Automatic Control . . . on-off or modulating controls.**
- **Long service life, low maintenance . . . stainless steel combustion chamber.**
- **Mobility . . . easily moved to any location.**
- **Flexibility . . . where floor space is limited, can be wall-hung or suspended from trusses.**

Planning a school building? Why not look into the possibilities of Dravo "Counterflo" Heaters for your heating and ventilating needs? Write today for Catalog NO—524-57

DRAVO CORPORATION
HEATING DEPARTMENT, DRAVO BUILDING, PITTSBURGH 22, PA.
Sales Representatives in Principal Cities

Manufactured and sold in Canada by Marine Industries, Ltd., Sorel, Quebec
Export Associates: Lynch, Wilde & Co., Washington 9, D.C.



VILTER REFRIGERATION UNITS *equipped with* ALLEN-BRADLEY TROUBLE FREE MOTOR CONTROLS

Vilter Refrigeration Units in a Detroit grocery equipped with A-B Bulletin 709 Solenoid Starters and Bulletin 712 Combination Starters....trouble free.

Why are Allen-Bradley starters so popular for refrigeration and air-conditioning service? . . . Because they do not require regular attention; they are trouble free. Only ONE moving part. No pivots, pins, or bearings to corrode or stick . . . no jumpers to break. You install them . . . and forget them!

No contact maintenance . . . Allen-Bradley patented silver alloy contacts never need cleaning, filing, or dressing.

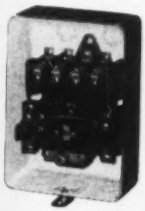
Dependable overload relays . . . Allen-Bradley thermal relays are dependable and remain accurate in their operation, even after long service.

The Allen-Bradley trademark stands for millions of trouble free operations.

Allen-Bradley Co., 1335 S. First St., Milwaukee 4, Wis.

A-B Quality

BULLETIN 709 SOLENOID STARTER



Bulletin 709 Solenoid Starter for automatic across-the-line starting of squirrel cage motors. These starters are built in eight sizes, having a maximum rating of 300 hp, 208-220 v; 600 hp, 440-550 v. Dependable relays provide accurate overload protection. No voltage protection. White interiors and ample space for ease of wiring. Size 1 starter shown.

ALLEN-BRADLEY SOLENOID MOTOR CONTROLS

NOW MORE THAN EVER...

YOU NEED

Bayley QUALITY...

When full production and utilization are so urgently needed as during the present emergency, breakdowns are particularly costly. Contrast the following profits realized on an investment in Bayley dependability:

USERS	DEALERS
Reduced maintenance	Less servicing, higher net
Lower depreciation	Satisfied users reorder
Sustained efficiency	Prestige gets new accounts

Forward Curved

Open Radial

Fan Wheels

Backward Inclined

Closed Radial

and ENGINEERING

The surest road to satisfaction with air handling apparatus is to avail yourself of Bayley's Engineering Know-how. Here are a few of the advantages to you:

- Every unit designed and built to maximum specifications
- Special designs or modifications to meet unusual conditions
- Standardized components for popular items facilitate stocking and quick delivery

If you need air engineering assistance, write us.

Static and Dynamic Balance

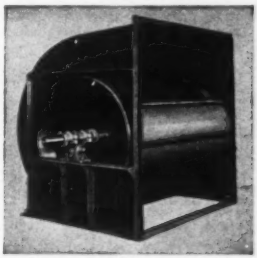
VERSATILITY . . .

You'll find plenty of opportunities to benefit through purchasing Bayley equipment, because the lines include:

- Centrifugal fans of all types
- Air Washers for comfort or process work
- Blast Coils and other air system auxiliaries

Get the best selection for the specified duty by choosing Bayley apparatus. Standard and special designs in full size ranges. No need to rely on makeshifts, or to compromise exacting specifications.

Plexiform Double-Width Ventilating Fan



Bayley AIR HANDLING EQUIPMENT

Performs better — longer

SPECIALISTS FOR OVER 50 YEARS

BAYLEY BLOWER COMPANY

6600 W. BURNHAM ST. MILWAUKEE 14, WIS., U. S. A.

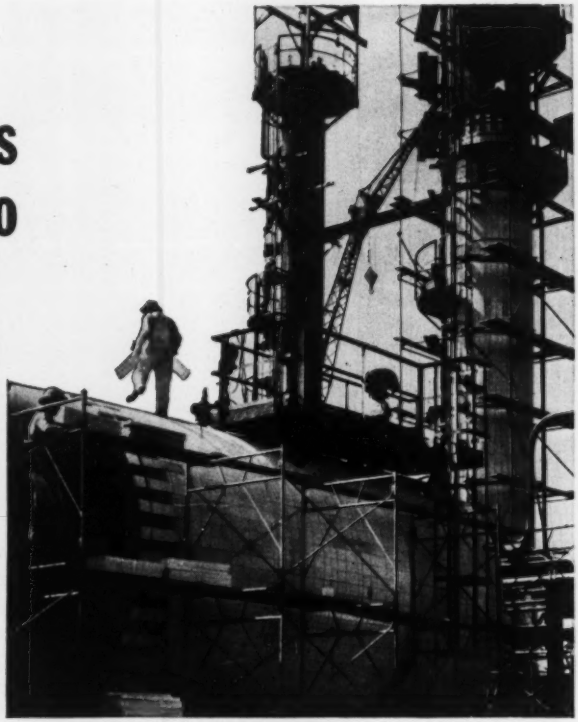
6 Reasons Why

Leading Refiners Are Switching to KAYLO HEAT INSULATION

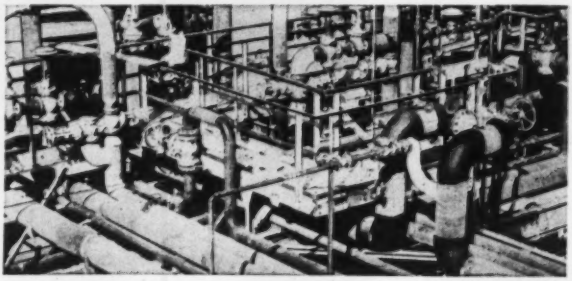
Through demonstrated superiority, Kaylo Heat Insulation is rapidly becoming recognized as the first basic advancement in the high temperature field in many years. Compare these advantages:

- Kaylo Heat Insulation is a calcium silicate (not glass)—an inorganic material which retains its stability in long service under severe conditions;
- Kaylo Heat Insulation has a wide effective temperature range—up to 1200°F.—eliminating need for combination covering in nearly all operating conditions;
- Kaylo Heat Insulation is insoluble in water. Work is not delayed by wet materials;
- High strength of Kaylo Heat Insulation practically eliminates spoilage both in transit and in application. Workmen can walk on insulated equipment without breaking insulation;
- Light weight along with high strength of Kaylo Heat Insulation makes application easier and faster;
- Simplified Dimensional Standards of Kaylo Pipe Insulation permit use of double layers for the higher temperatures without the use of special materials.

It will pay you to investigate the advantages offered by Kaylo Heat Insulation.



Applications of Kaylo Heat Insulating Block and Kaylo Pipe Insulation, The Texas Company Refinery, Lawrenceville, Illinois. M. W. Kellogg Company, New York, Designer and Builder. New construction includes units for fluid catalytic cracking, fractionation, gas recovery and catalytic polymerization.

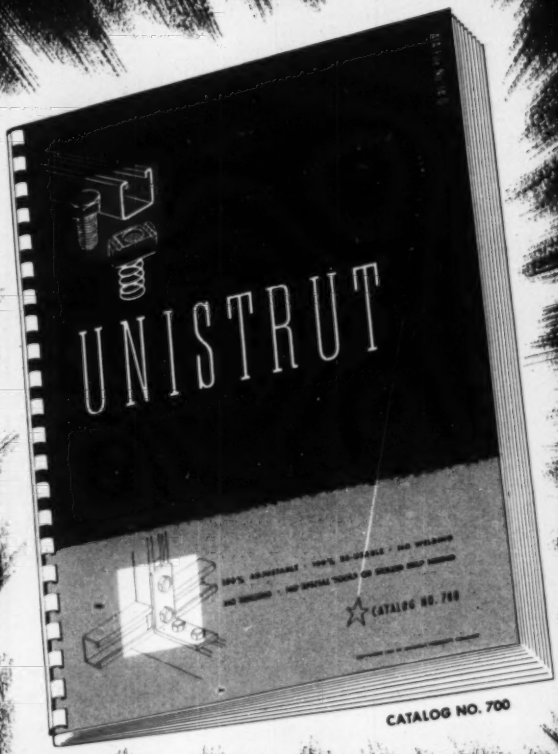


For complete details on Kaylo Heat Insulation, write Dept. N-198, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

KAYLO® ... *first in calcium silicate*

...*pioneered by* OWENS-ILLINOIS Glass Company

MAIN OFFICE: TOLEDO 1, OHIO—KAYLO SALES OFFICES: ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND DETROIT • HOUSTON • MINNEAPOLIS • NEW YORK • OKLAHOMA CITY • PHILADELPHIA • PITTSBURGH • ST. LOUIS • WASHINGTON



NEW UNISTRUT

With UNISTRUT you can build all types of framing, mounts, shelving, racks, tables and benches—conduit, cable, pipe and tubing hangers and supports—fluorescent fixture supports, and many other structures with just a hacksaw and a wrench.

UNISTRUT is metal channel with a continuous slot. You simply insert the UNISTRUT spring-held clamping nut into the channel at approximate point where attachment of another framing fitting is desired, slide to exact location and bolt to UNISTRUT fitting.

UNISTRUT includes concrete inserts, roller pipe supports, brackets, clamps and many other standard parts which in combination provide the world's most flexible system of support or suspension. UNISTRUT does the complete job—you need no other parts or materials.

UNISTRUT is trim framework—provides great strength without bulk. It's easy to work with, lasts indefinitely, and the finished structure assures neat and orderly appearance.

UNISTRUT PRODUCTS COMPANY
1013 W. Washington Blvd., Chicago 7, Ill. Dept. H-7
Representatives and Warehouse Stocks in Principal Cities
Consult your Telephone Directories

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2327587 2363382
2329815 2380379
2345650 2405631
2541908
Other Patents Pending

UNISTRUT IS *Bonderized!*

The World's Most Flexible All-Purpose Metal Framing

Please send items checked below, without obligation:

☐ Catalog 700 ☐ 24" x 36" Wall Chart
☐ Free Unistrut Sample

Name_____

Company_____

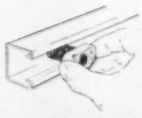
Address_____

City_____ Zone____ State_____

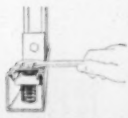
Only **UNISTRUT**
GIVES YOU THIS FAST CLAMPING, LOCKING ACTION AND THIS COMPLETE ADJUSTABILITY AND RE-USABILITY

1 WEDGE SHAPED INTURNED EDGES TO TAKE SERRATED GROOVES OF UNISTRUT NUT.

2 SERRATED GROOVES "BITE INTO" INTURNED EDGES OF CHANNEL FOR POSITIVE CLAMPING ACTION.


3 INSERT SPRING NUT ANYWHERE ALONG CONTINUOUS SLOT OF CHANNEL.

4 ROUNDED EDGES OF NUT PERMIT EASY INSERTION. SPRING (YOUR THIRD HAND) HOLDS NUT SNUGLY IN PLACE FOR BOLTING.


5 ASSEMBLE FITTING, NUT AND BOLT—A TURN OF THE WRENCH, IT'S DONE.

UNISTRUT PRODUCTS COMPANY

where

PERFORMANCE *and* APPEARANCE

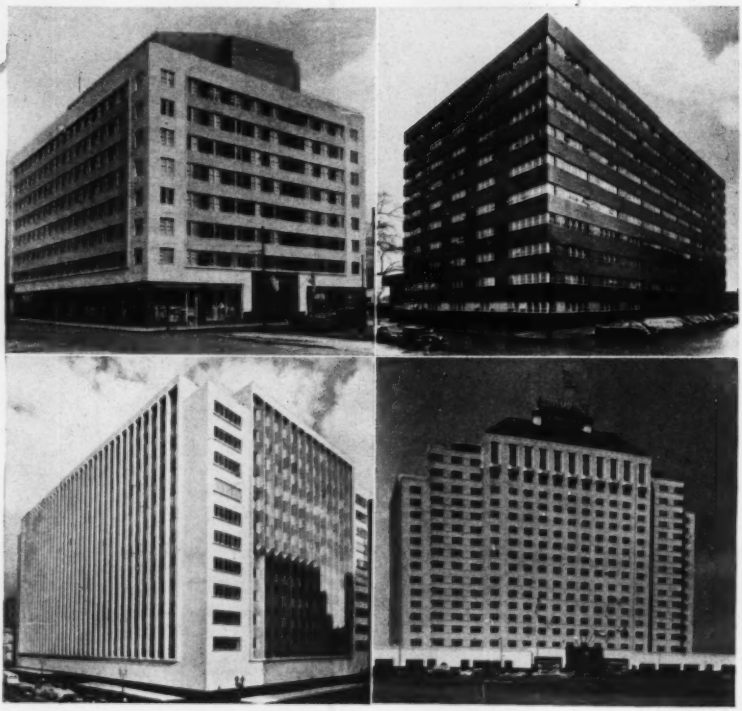
are determining factors

you will find

BARBER COLMAN

uni-flo®

Engineered Air Distribution Products



● Right, California Building, New Orleans, La. Architects, Herbert A. Benson and George J. Riehl; Engineer, Cary B. Gamble and Associates; General Contractor, Keller Construction Co.; Mechanical Contractor, Emile M. Babst Co. — all of New Orleans.

● Far right, Allstate Insurance Company Building, Chicago, Illinois. Architects, Carr and Wright, Inc.; Consulting Engineer, Robert E. Hattis; Heating Contractor, Gallaher and Speck, Inc.; Ventilating Contractor, Acord Ventilating Co. — all of Chicago.

● Right, General Petroleum Office Building, Los Angeles, California. Architect, Wurdeman & Becket; Mechanical Engineer, Ralph E. Phillips; Air Conditioning Contracting Engineers, W. S. Kilpatrick Co. — all of Los Angeles.

● Far right, Shamrock Hotel, Houston, Texas. Architects and Engineers, Wyatt C. Hedrick, Inc.; Mechanical Contractors, Associated Mechanical Contractors, Inc. — all of Houston.

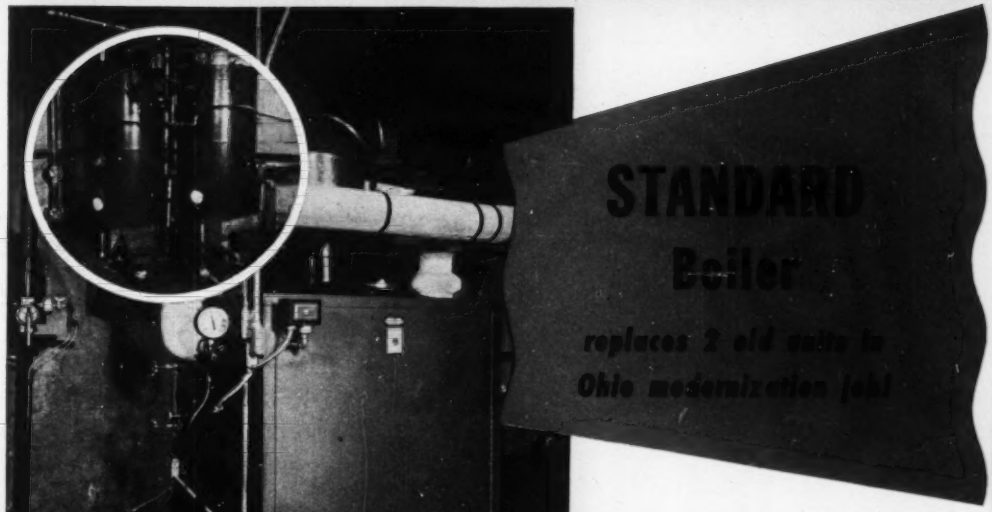
BARBER COLMAN

BARBER-COLMAN COMPANY

1228 ROCK STREET, ROCKFORD, ILLINOIS

AMERICAN-Standard

First in heating...first in plumbing



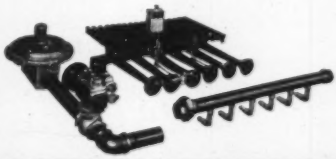
SUTTON & LIGHTNER, LTD., one of Marion, Ohio's smartest apparel shops, doesn't have to worry about the comfort of its customers in cold weather since the installation of this modern American-Standard unit by the Reliable Plumbing & Heating Company, of Marion. Replacing the two boilers shown in the circle, the single gas fired Standard 4-GS-9 Boiler is not only a dependable source of heat, but it is considerably more economical to operate.

Standard Boilers come in a wide range of sizes to provide effortless gas heating in larger homes, apartment buildings, hospitals and various commercial and industrial buildings. They can be used in battery installations in larger buildings to provide an extremely flexible heat source through the operation of one or more units, thus giving greatly increased economy during mild weather, as well as perfect comfort in the coldest weather.

Standard Boilers and other top quality heating equipment by American-Standard are sold through selected wholesale distributors to heating and plumbing contractors. **American Radiator & Standard Sanitary Corporation,** P. O. Box 1226, Pittsburgh 30, Pa.

Precision-machined and sub-assembled to facilitate quick and easy installation

Standard Boilers have cast iron sections which are precision-machined to facilitate quick and easy assembly. Individual sections may be conveniently carried through any ordinary doorway. To save further time and labor, controls, valves, and control piping are factory assembled as far as possible.



Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

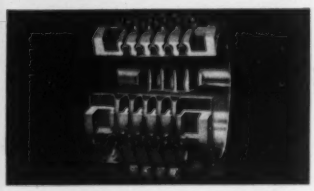
Zallea Expansion Joint News

PUBLISHED BY ZALLEA BROTHERS—WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS

Expansion Joint of the Month

DUO EQUALIZING TYPE

The ideal corrugated expansion joint is one in which all corrugations move simultaneously during expansion or contraction of the piping, and no corrugation can be compressed or extended more than the proportionate amount for which it is designed. This briefly describes the Zallea Duo Equalizing Expansion Joint, so called because it functions in two ways: equalizing the compression among the corrugations simultaneously when the pipe line is expanding and likewise distributing the elongation simultaneously and proportionately among all the corrugations when the line is contracting.



This is accomplished by the simple expedient of a pantograph. Two or more pantographic chains are superimposed on the equalizing rings of the expansion joint, the neutral points being anchored in the end fittings and intermediate equalizing rings. Any movement of the end fitting is immediately and simultaneously transmitted to all equalizing rings. In this manner all the equalizing rings move the same relative distance at the same time. This Zallea Joint is recommended for all intermittent steam services in long lines, institutions, and industrial plants.

. . . a brand new 4-page folder on *all* Zallea Expansion Joints. Send for your copy of Bulletin 351 today!

ZALLEA BROTHERS, 816 Locust Street, Wilmington 99, Delaware.

WORDS YOU DON'T EXPECT:

"Guaranteed Delivery"

Restrictions . . . allotments . . . priorities . . . material shortages . . . backorders . . . uncertainty . . .

Take your choice . . . these are familiar words to industrial buyers today.

Not too often, however, does the industrial buyer hear those seemingly long-lost words, "Guaranteed Delivery".

This is especially true about stainless steel expansion joints.

You've all heard the well-worn "we'll-take-your-order" routine. But delivery date? That's something else again!

Like many an industrial faced with expansion problems, you know all-too-well that you can't afford to risk shutdowns today because of unsatisfactory or inadequate expansion joint performance. Production *must* be kept moving at the required fast pace.

Here's the unexpected!

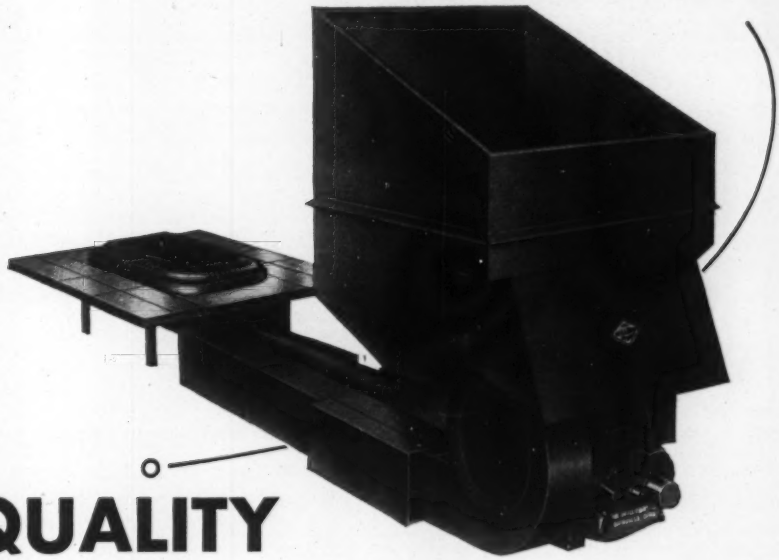
We are in a position to fill your standard expansion joint needs . . . promptly! (6 weeks on large orders, 4 weeks on medium orders and *2 to 3 days on emergency orders, if necessary.*)

The reason isn't too unusual. As the world's largest manufacturers of expansion joints, we maintain, at all times, a complete stock of component parts. Many months ago, we here at Zallea Brothers anticipated today's critical material situation, and did something about it. Today, we have an adequate supply of stainless steel *on hand.* We do not have to wait for mill deliveries.

We realize, however, that our stocks won't last forever . . . far from it. But so long as we can keep turning out *quality* expansion joints that will give you the lasting performance you want, you are assured of *guaranteed delivery* on all Zallea standard units.

Sol Zallea

STOKER SALES OFF?
Not Will-Burt!



QUALITY
Makes Sales When Sales Come Hard

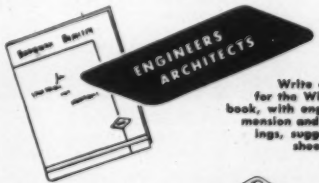
Will-Burt stoker sales are *up!*

Why? We're carrying on no special promotion — our advertising has not been increased. But for twenty years the knowledge has been spreading that Will-Burt is a good company with which to do business. Ask anyone who has specified, sold or used a Will-Burt stoker. The engineer or architect will say something like this: "Yes, it is accepted without question." The dealer or distributor: "It sells at reasonable prices and our profit isn't eaten up by excessive service calls." The user: "It must be good; we certainly have low coal bills and never any trouble."

Will-Burt stokers have always been designed and built better than the necessities demand.

We have always put *extra* quality into Will-Burt stokers, and it is now paying off in increased sales.

If you want to do business with a company whose integrity can never be questioned, whose product is above-average, and who feels business can be pleasurable as well as profitable, drop us a line. ***Now you know . . .*** Will-Burt quality makes sales when sales come hard.



Write on your letterhead for the Will-Burt stoker data book, with engineering facts, dimension and installation drawings, suggested specification sheets, etc. Valuable!

OTHER WILL-BURT HEATING PRODUCTS

Gas and oil conversion burners

Residential hot-water heating boilers

WILL-BURT

THE WILL-BURT COMPANY

DEPARTMENT H ORRVILLE, OHIO

Putting Heat and Cold in their places

Here, PC Foamglas, in standard flat blocks and preformed sections, is being used to insulate the walls and pipe lines of the yeast culture room at the United States Brewer's Academy, Mount Vernon, N. Y.

● This unique material has proved its ability to do an effective insulating job in walls and ceiling, on roofs and under floors . . . on hot or cold piping and in handling equipment . . . over unusually long periods of time.

Long lasting effectiveness and freedom from costly repairs, maintenance and replacement, make Foamglas—on a cost-per-year basis—the most economical insulation you can use.

When you are figuring on insulation, make sure you have the latest information on PC Foamglas. Send in the convenient coupon for a sample of Foamglas and copies of our informative booklets.

PITTSBURGH CORNING CORPORATION, PITTSBURGH 22, PA.

The **best** glass insulation is cellular glass. The **only** cellular glass insulation is PC Foamglas. This unique material is composed of still air, sealed in minute glass cells. It is light weight, incombustible, verminproof. It has unusually high resistance to moisture, chemicals and other elements that cause insulation to deteriorate.

Pittsburgh Corning Corporation
Dept. AF-71, 307 Fourth Avenue
Pittsburgh 22, Pa.

Please send me without obligation a sample of Foamglas and your FREE booklets on the use of PC Foamglas Insulation for Normal Temperature Commercial, Industrial, and Public Buildings ☐ Refrigerated Structures ☐ Piping and Equipment ☐.

Name.....

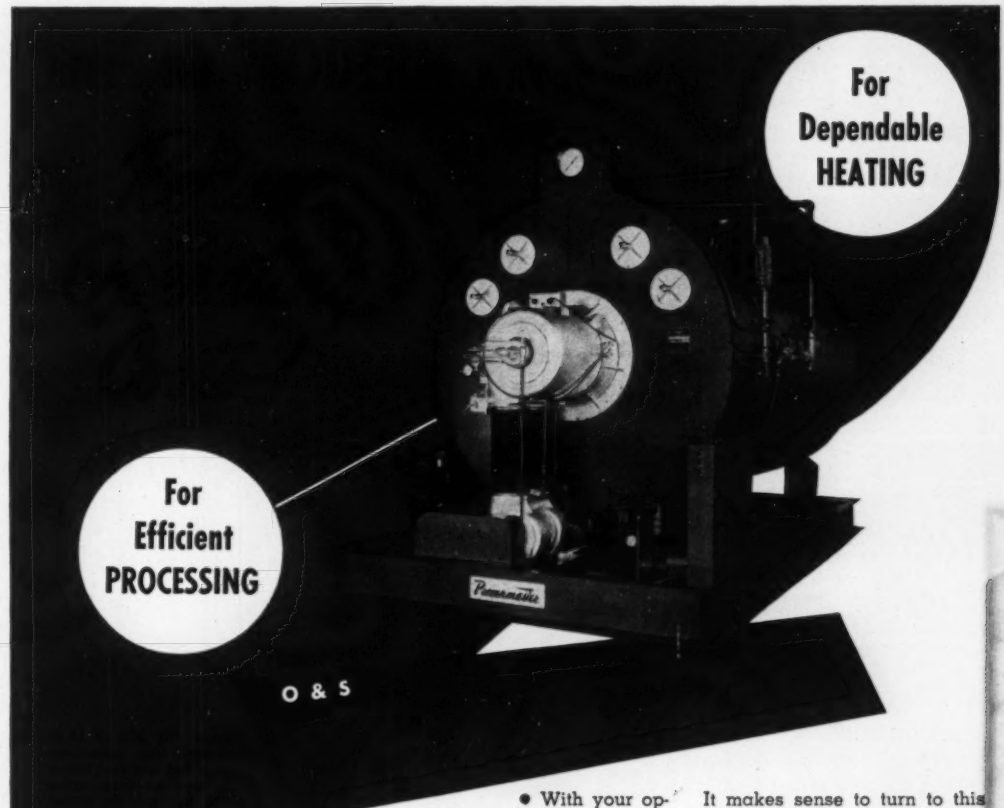
Address.....

City.....State.....

PITTSBURGH ® PC CORNING

FOAMGLAS cellular glass INSULATION

. . . when you insulate with FOAMGLAS . . . the insulation lasts!



• With your operating costs growing higher than ever, isn't this a mighty good time to take a look at your boiler room? That's where efficient, cost-saving plant operation should start.

Maybe your boiler is eating fuel dollars. Perhaps it's inadequate to meet your greater steam demands. Chances are it's obsolete at today's standards. You may find it possible to cut costs enough to actually pay for a new O&S *Powermaster* unit in two or three years. Many *Powermaster* users tell us they *have!*

It makes sense to turn to this up-to-date self-contained unit to produce the steam or hot water you need. All Powermaster components are sized to coordinate most efficiently as a fully automatic packaged unit. You'll reduce operating costs (as much as 40%) and cut maintenance time to a minimum. You'll be sure of safe, smokefree, dependable operation.

Write today for complete information on a Powermaster unit for your specific needs. Or send coupon for latest bulletin describing all units.

Powermaster®

STEAM GENERATORS
AND HOT WATER BOILER UNITS

Orr & Sembower, Inc.
990 Morgantown Rd., Reading, Pa.

Please mail latest catalog showing Powermaster's cost-cutting advantages.

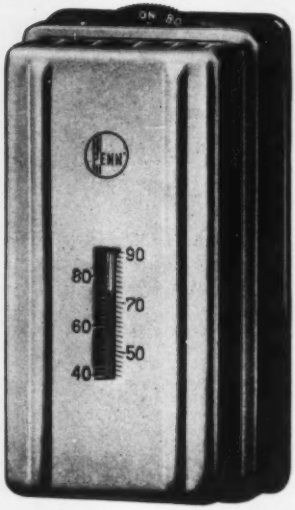
Name_____

Company_____

Address_____

summer ventilation

winter fuel economy



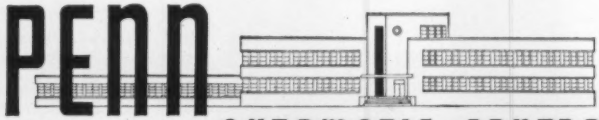
with 1 Unit Heater Control

A *built-in ON-OFF switch* is one of the PLUS VALUES in the PENN unit heater thermostat which enables you to get *two jobs* done with one control.

During winter months, this switch is a great *fuel-saver*. A mere rotation of the dial to "OFF" position stops heat flow during idle periods . . . or to little used areas . . . or to areas where heat can escape, such as receiving or shipping rooms which may be exposed to outside temperatures for long periods. In addition, the PENN heat-anticipating thermostat holds temperatures closer to the selected level . . . eliminates wasteful "zig-zag" heating.

Then in summer months, this same ON-OFF switch makes it possible to use the unit heater fan for *ventilation* without installing an additional switch. The ON-OFF feature permits manual control of fan operation whenever desired. For continuous operation, you merely rotate the dial to ON position.

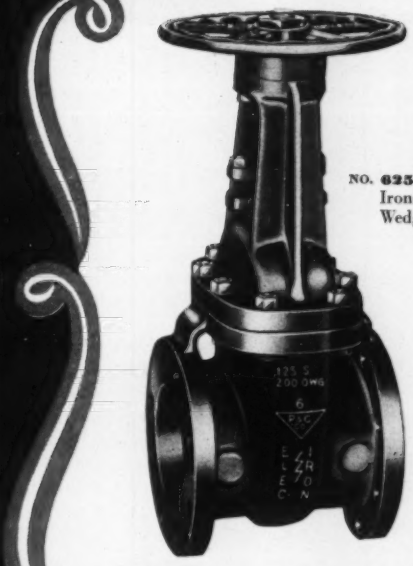
Learn more about this *better control* for unit heaters. Ask your manufacturer, wholesaler or write **Penn Electric Switch Co., Goshen, Indiana.** Export Division: 13 E. 40th St., New York 16, N. Y., U.S.A. In Canada: Penn Controls, Ltd., Toronto, Ontario.



AUTOMATIC CONTROLS

FOR HEATING, REFRIGERATION, AIR CONDITIONING, PUMPS, AIR COMPRESSORS, ENGINES, GAS RANGES

R·P&C VALVES



NO. 625
Iron Body
Wedge Gate

You Pay No More For These Extra Values

In R-P&C's Iron Body Gate Valve you get . . .

Highest quality cast iron made by R-P&C's advanced electric furnace melting process. This fine-grained iron offers physical properties far exceeding specification minima.

Reinforcing tie ribs between bonnet and end flanges. This gives added strength to valve body.

Yoke cap construction. This imparts ruggedness plus ease of repair.

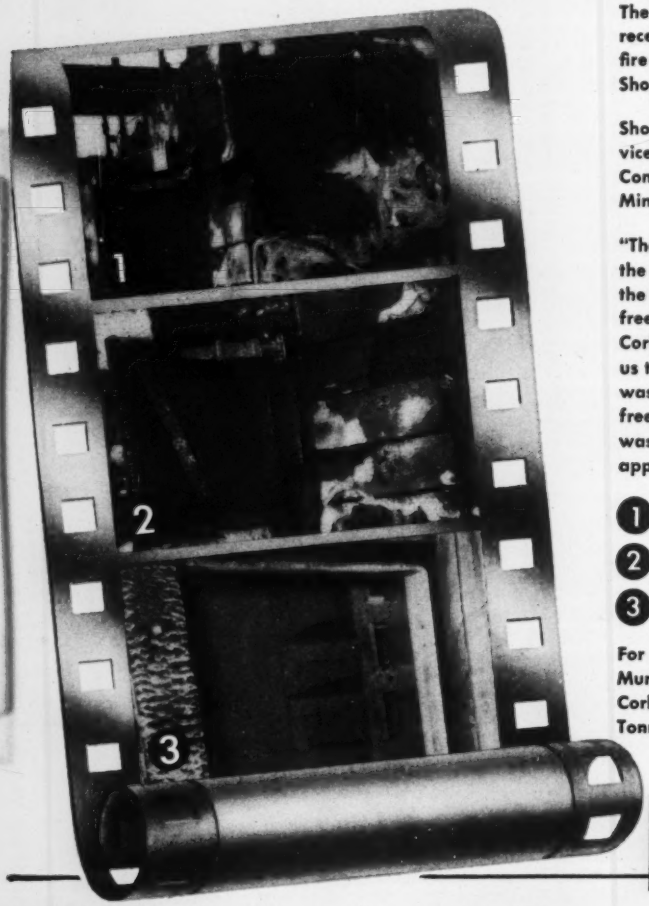
Ask your local R-P&C distributor about this extra value Iron Body Gate Valve—or write the nearest R-P&C district office.

"Intentionally Better"
READING-PRATT & CADY VALVES

R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

FOOD FREEZER WITHSTANDS ST. PAUL'S WORST FIRE!

Freezer Contents, Protected by Mundet Cork Insulation, Found in Solid Frozen State Day After Fire . . . Food Approved for Sale by Health Inspectors.



The Cut Price Super-Market was destroyed recently, in a spectacular two million dollar fire that razed most of the Highland Park Shopping Center in St. Paul.

Shortly after the fire, Mr. Neil B. Herman, vice president of the Allied Store Equipment Company, Mundet sales representative in Minneapolis, sent us this report:

"The amazing thing about this fire was that the only part of the store left standing (even the brick walls were gone)—was the walk-in freezer, insulated with 6 inches of Mundet Corkboard. The operators of the Market told us that the only thing salvaged from the fire was all of the frozen food which was in this freezer. The day after the fire, the frozen food was still in a solid frozen condition and was approved for sale by the Health Inspectors."

1. *Walk-in freezer at Cut Price Super-Market, still intact and serviceable after 4-alarm fire.*
2. *Charred exterior of freezer door offers evidence of surrounding heat during fire.*
3. *This unretouched photo taken after the fire shows undamaged interior of the freezer.*

For information on Mundet Corkboard and Mundet Insulation Services, write to Mundet Cork Corporation, Insulation Division, 7101 Tonnelle Ave., North Bergen, N. J.

MUNDET
CORK INSULATION

ATLANTA: 339-41 Elizabeth Street, N.E.
BALTIMORE 30: 612 Battery Ave.
BOSTON: 57 Regent St., North Cambridge 40
CHARLOTTE, N. C.: 507 S. Cedar Street
CINCINNATI 2: 427 West 4th Street
DALLAS 10: 601 Second Ave.
DETROIT 21: 14401 Prairie Street
HOUSTON 1: Commerce and Palmer Streets

Mundet district offices are conveniently located coast-to-coast.

INDIANAPOLIS: 15 E. Washington St.
JACKSONVILLE 6, FLA.: 800 E. Bay St.
KANSAS CITY 7, MO.: 1401 St. Louis Avenue
KNOXVILLE: 1221 Grand Ave.
LOS ANGELES: (Maywood) 6116 Walker Ave.

NEW ORLEANS 16: 315-25 N. Front Street
NEW YORK 17: 331 Madison Ave.
PHILADELPHIA 39: 856 N. 48th Street
ST. LOUIS 9: 3176 Brannon Ave.
SAN FRANCISCO 7: 440 Brannan Street

In Canada: Mundet Cork & Insulation, Ltd. 35 Booth Avenue, Toronto

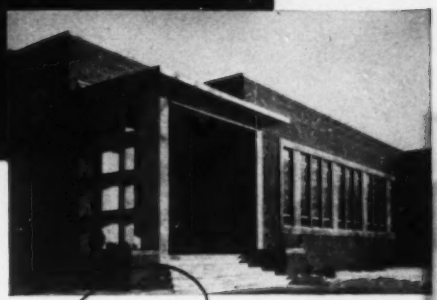
Write us for name of our nearest representative if there is no Mundet office in your city.

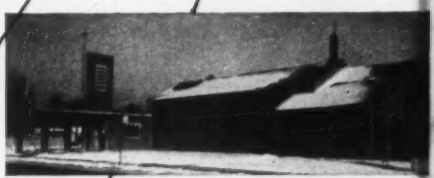
"I specify Jackson & Church

WARM AIR HEAT *for*

three important reasons"

EARL L. CONFER, ARCHITECT
14000 STRATHMOOR, DETROIT 27, MICH.





"For heating installations in religious buildings, I specify Jackson & Church Warm Air Heat.

"First of all, most J-C furnaces can be obtained as package units, and are easily adapted to the space restrictions usually found.

"Secondly, J-C equipment has been found dependable in service.

"Thirdly, the Jackson & Church firm supports a progressive effort in meeting new and special conditions as they develop in the work.

"Heating systems for these religious buildings range in size from 300,000 Btu to 2,000,000 Btu, requiring sectionalizing with three or more zones, automatically controlled. *The savings realized by specifying Warm Air Heat amount to many thousands of dollars!"*

. . . America's largest and most complete warm air heating line . . .

J-C

is as bad as dirty filters!

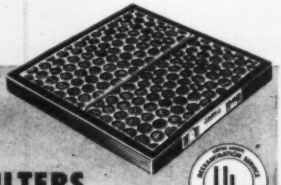
Get this Booklet—The "Comparative Study of Air Filtering Costs" contains facts, figures and charts important to anyone interested in air conditioning. A copy free on request. Write today.

Sure, it's crazy . . . nobody would choke off the air conditioning intentionally! But you get roughly the same effect when you let dirt-choked air filters remain in your system. You lose comfort and raise your costs.

Regular, periodic replacement of filters is a *must* if you want to get good air conditioning and avoid costly repairs. How often should you replace them? As often as they get dirty . . . and that depends on your local conditions . . . in some cases as often as once a month.

Be sure your filter replacement is handled on a definite schedule, using nationally known and accepted Fiberglas DUST-STOP* Air Filters, the replacement filters that provide high dirt-catching capacity at no extra cost.

Your DUST-STOP supplier can help you set up a way of handling filters systematically. Discuss it with him today. Owens-Corning Fiberglas Corporation, Dept. 40-G, Toledo 1, Ohio.



OWENS-CORNING FIBERGLAS DUST STOP* AIR FILTERS

*T. M. REG. U. S. PAT. OFF.

*DUST-STOP is the trade-mark of Owens-Corning Fiberglas Corporation for impingement type air filters made of glass fibers. FIBERGLAS is the trade-mark (Reg. U. S. Pat. Off.) of Owens-Corning Fiberglas Corporation for a variety of products made of or with fibers of glass.

CUTS DAMAGE AND REPLACEMENT COSTS

NEW HEAVY-DUTY INDUSTRIAL GRILLE

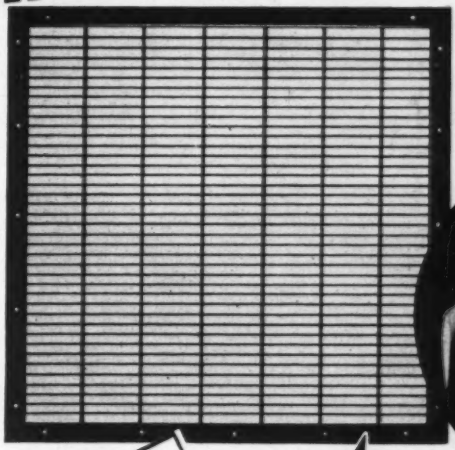
CUSTOMED FOR FACTORY USE AND ABUSE

This grille especially designed for Atomic Energy Commission.

Contractors—
Maxon Construction Company

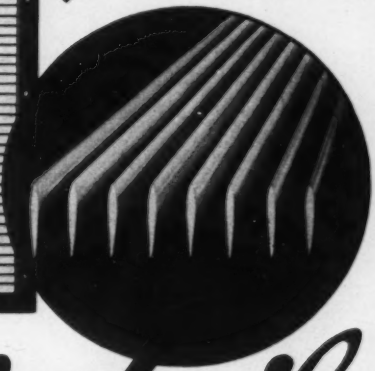
Eng. & Arch.—
Giffels and Vallet, Inc.
L. Rossetti Associated, Eng. & Arch.
1000 Marquette Building
Detroit, Michigan

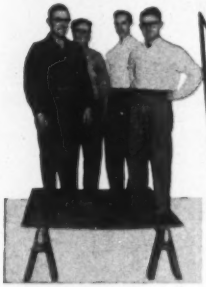
- 14 GAUGE STEEL BLADES
- VERTICAL SUPPORT BARS PLACED ON 6" CENTERS (14 GAUGE STEEL)
- STANDARD GRADE PRIMER COAT FINISH
- 16 GAUGE STEEL, EXTRA WIDE BORDER FOR EASY MOUNTING



At left—Grille face of LOWER WALL, INDUSTRIAL GRILLE. Note close spacing of extra-strength blades (⅜" centers).

Below—Close-up view of volume control section. Note famous solid section AIRFOIL LOUVERS. Each blade is individually adjustable. CONCEALED LOUVER SUPPORT eliminates mullions and butted construction.





At left—photo shows the 48" x 48" AIRFOIL INDUSTRIAL GRILLE supporting the combined weight of 4 Titus factory workers.

Air Foil
AIR CONDITIONING OUTLETS

Write for new, FREE complete catalog of Titus AIRFOIL air conditioning outlets—the most efficient grilles ever designed.

Free

More highly efficient . . . longer lasting . . . brand new . . . that's the AIRFOIL-DESIGNED, AIRFOIL-BUILT INDUSTRIAL GRILLE. Clean cut—compact—it is made in two sections . . . Grille Face and Volume Controller.

Rugged—braced for super-strength. The INDUSTRIAL GRILLE will stand up for years and years against the punishing knocks—jars—shocks—scratches and abuse that floor level grilles must take.

Volume Controller section features the famous solid section, streamlined AIRFOIL LOUVERS. Noise and turbulence are cut to a minimum. At the same time, perfect draft-free, air distribution is assured.

CHECK TYPE OF GRILLE ON WHICH INFORMATION IS DESIRED

- ☐ Air conditioning outlets
- ☐ Return air grilles and registers
- ☐ Volume controllers
- ☐ Perforated metal and ornamental grilles
- ☐ Door ventilators
- ☐ Special made-to-order grilles

TITUS MANUFACTURING CORP., WATERLOO, IOWA

- ☐ Rush information on Industrial Grilles.
- ☐ Send complete catalog.
- ☐ Send literature on above checked items.

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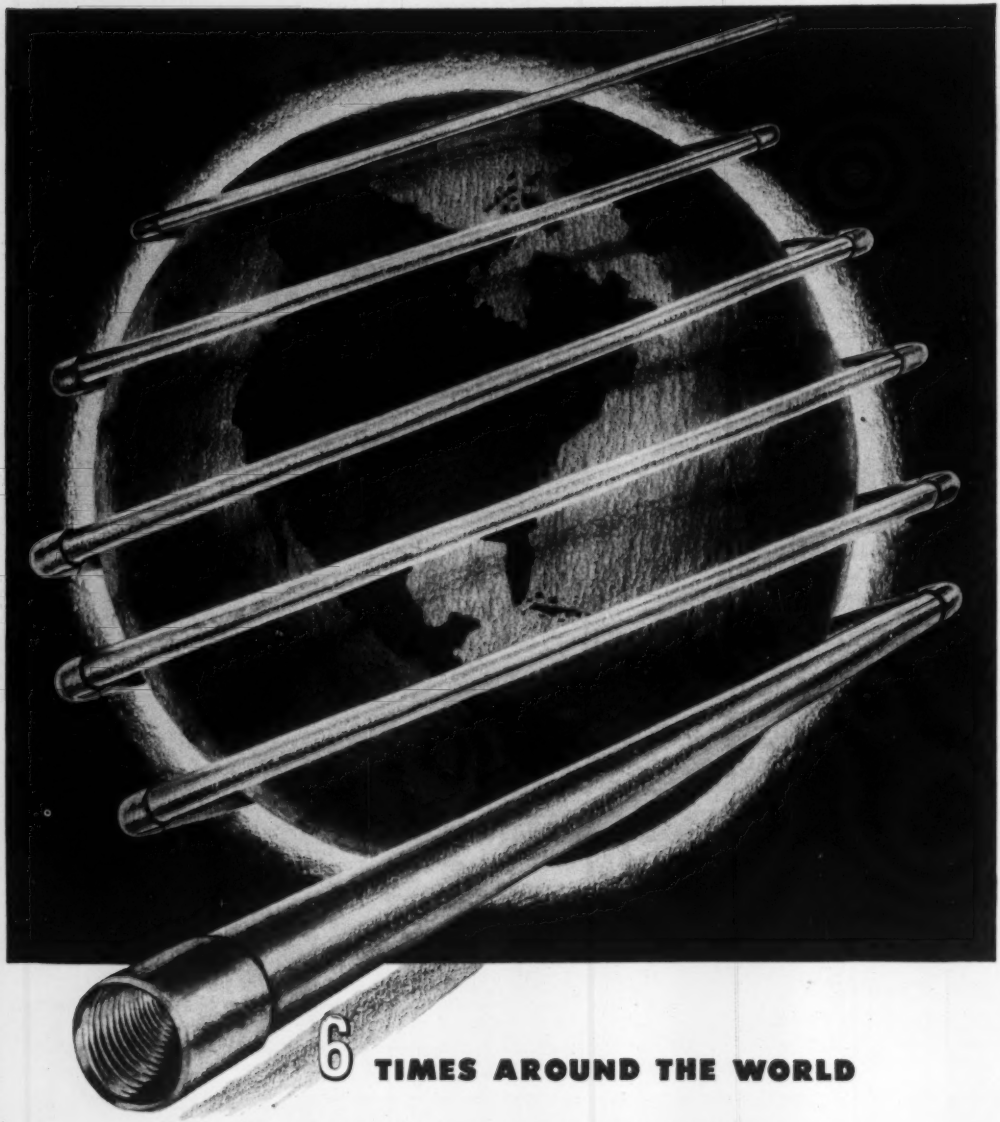
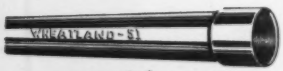
CITY_____ STATE_____



6 TIMES AROUND THE WORLD

Oil keeps the wheels of industry humming in normal times—becomes the life-blood of a nation when that nation arms. Over 152,000 miles of pipe-lines, *enough to circle the world 6 times,* are needed to keep up the flow of oil. Wheatland is proud of the role played by "the pipe with the yearmark" in this vast arterial system at work to help keep the free world strong—*and free.*



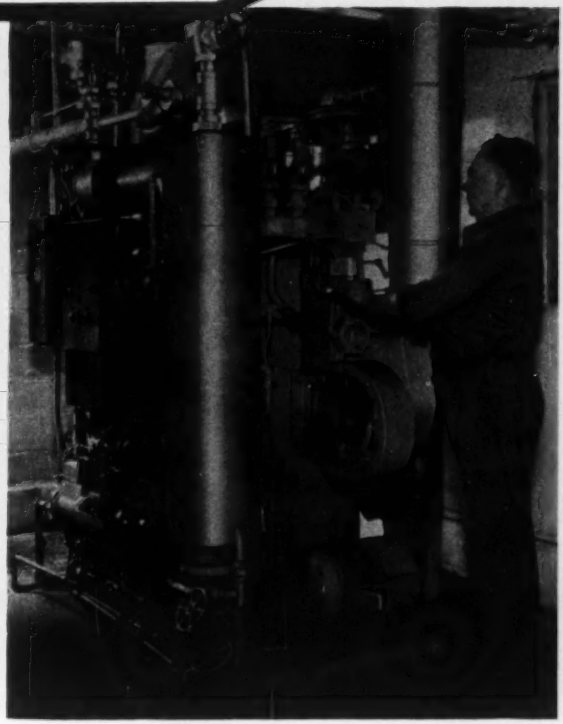
-pipe with the yearmark!

WHEATLAND TUBE COMPANY

BANKERS SECURITIES BLDG., PHILADELPHIA 7, PA.

Help keep America strong and free. Get in your scrap now—*today!*

More than a Package Boiler...
A PACKAGED STEAM PLANT



Do you need steam for . . .

. . . heating or processing . . . continuous or intermittent service (or both) — in unit capacities up to 6,000 pounds per hour — for pressures up to 300 psi?

. . . remote locations involving the expense of installing and maintaining long insulated pipe lines?

. . . an occasional load which may exceed the capacity of existing boilers?

. . . a highly fluctuating load which involves sudden heavy demands?

. . . conditions which require maximum output from minimum space, completely automatic operation and a minimum of attention.

• • •

If you do — if you have any one or a combination of these requirements — your best bet is the C-E Re-circulation Steam Generator. It's *more* than a package boiler — it's a complete steam plant including all controls and auxiliaries — a fully integrated unit. Investigate this unit before you buy any boiler in its capacity range. B-507

Send for recently issued bulletin p-323a

COMBUSTION ENGINEERING — SUPERHEATER, INC.

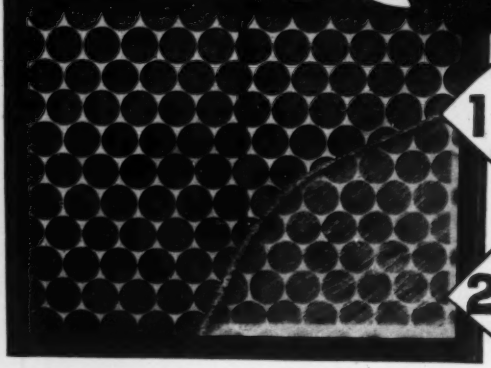
200 Madison Avenue, New York 16, N. Y.

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

DUST IS OUT BECAUSE IT'S IN*

The NEW IMPROVED Glasfloss AIR FILTER

IMPINGEMENT IS STRAINER



1 THE STANDARD HIGH EFFICIENCY GLASFLOSS AIR FILTER PAD....

PLUS

2 GLASFLOSS STRAINER MAT THAT MAKES DUST FILTERING UP TO 98% EFFICIENT!

* Dust is OUT of the air because it's permanently trapped IN the new, improved Glasfloss I-S (IMPINGEMENT-STRAINER TYPE) AIR FILTER. Higher efficiency factor of 95% to 98%. Resistance, normal.

To the famous, long fine glass fibres of the standard Glasfloss Air Filter pad has been added our exclusive STRAINER MAT feature. Combined, these two elements excel for dust and dirt air filtering. The improved Glasfloss I-S AIR FILTERS are available in 2" thicknesses —in all standard sizes. They broaden your sales opportunity because they are ideal for paint-spray booths in automotive, aircraft and enameling operations; for food processing plants; pharmaceutical and soap manufacturers; television studios; restaurants and dining rooms; hospitals, schools and all public buildings—anywhere in the business and industrial world where clean air is important. Increased profits, more satisfied customers are the plus values you can expect from Glasfloss I-S (IMPINGEMENT-STRAINER) AIR FILTERS. Write today for complete information. Address Dept. HP-7.

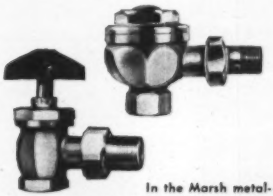
Glasfloss 155 EAST 44th STREET, NEW YORK 17, N. Y.

Permanent Valves and Traps for a Permanent Building . . .

Federal Office Building
NASHVILLE, TENNESSEE

Architects — Engineers:
Marr & Holman, Nashville

Plumbing and Air Conditioning Contractors:
J. M. Gallagher Company, Nashville



In the Marsh metal-to-metal seal you have the finest packless valve construction and in the Marsh radiator trap you have the most efficient team-mate for it. This combination was widely used in the Nashville Federal Office Building.

This Marsh float and thermostatic trap is typical of a wide line of Marsh traps for all services. Many are installed at Nashville.

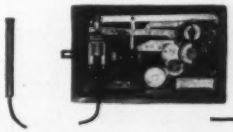
Impressive even in the vast building program of the Public Buildings Administration is this big Federal Office Building at Nashville, Tenn.

Buildings like this are built to function faultlessly, with a minimum maintenance, for a long, long time to come. This is also the distinguishing characteristic of Marsh Heating Specialties. So the choice of Marsh Valves and Traps for this massive structure is entirely logical.

At the right of the illustration you see a part of the stately Nashville Post Office. Erected in the late thirties and also equipped with Marsh Heating Specialties, it stands as another example of a permanent building provided with permanent heating equipment.

Indeed this respect for Marsh quality is demonstrated on a nation-wide scale in the selection and specification of Marsh valves, traps, vents and controls for finer buildings, large and small, in every part of America. Use Marsh equipment on your next job and you will see in its advanced design and trouble-free service why it is the first choice of the most discriminating heating men.

MARSH HEATING EQUIPMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*
Dept. T, Skokie, Ill.



BIG FUEL SAVINGS — WITH HEAT REGULATION IN STEP WITH THE WEATHER.
Maximum comfort with minimum heating costs . . . that is what the Marsh-Tritrol accomplishes by controlling heat in step with outside weather. Ask for facts.

MARSH *Heating Specialties* **SINCE 1865**

It's new... so it's MARLEY!

MARLEY
Laminated Fan Cylinder
PATENT APPLIED FOR
THE MARLEY CO., INC.
KANSAS CITY, KANSAS

Cooling Tower Fan Cylinders

that are entirely new, distinctive in design . . . are another major addition to Marley's long list of achievements in cooling tower advancement.

Laminated Fan Cylinders are the sturdiest ever applied to cooling towers. Built entirely of overlapping layers of redwood boards, they are structurally strong . . . uniformly strong at every point. No metal shape rings or clamp strips are needed; there is nothing to corrode, loosen or vibrate. Laminated Fan Cylinders are built of the same material as the towers they serve . . . built to last as long.

MODERNIZE ANY LARGE INDUCED DRAFT TOWER

Laminated Fan Cylinders will reduce maintenance time and upkeep expense on *any* large cooling tower. No painting, no replacing rusted metal parts — you check fan cylinders off the maintenance list when you install modern Laminated Fan Cylinders. Engineers have ordered many of these fan cylinders for replacement since Marley recently made them available.

also producers of
DOUBLE-FLOW TOWERS
CONVENTIONAL TOWERS
DRICOOLERS
NATURAL DRAFT TOWERS
SPRAY NOZZLES

For detailed information, call your Marley representative or write for LP-30a.

The Marley Company, Inc.
KANSAS CITY 15, KANSAS

MARLEY

HOFFMAN

PRESSURE REDUCING VALVES

TEMPERATURE REGULATORS

Made of brass in ½", ¾", 1", 1¼" and 1½" sizes.

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VALVES • TRAPS • PUMPS

HOFFMAN SPECIALTY COMPANY
1001 YORK ST., Dept. P-6, INDIANAPOLIS 7, IND.
Makers of Valves, Traps, Vacuum and Condensation Pumps, Forced Hot Water Heating Systems
Sold by leading wholesalers of Heating and Plumbing Equipment.

Guardians of Your Health and Comfort

AEROFIN

Heat-Transfer Surface

Aerofin is sold only by manufacturers of nationally advertised fan system apparatus. List on request.

● High Efficiency
● Long Service Life
● Low Maintenance Costs

You are assured of high efficiency in heating or cooling — long service life — low maintenance and service costs, when you specify Aerofin extended-surface heat exchangers.

The reason is obvious: Aerofin makes heat exchangers *exclusively* — offers you the results of unequalled experience, unequalled production facilities, unequalled materials testing and design research — and the guidance of a complete, highly skilled engineering staff, at the plant and in the field.

For the most practical solution to your heat-exchange problem, ASK THE AEROFIN MAN.

AEROFIN CORPORATION
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Remember –

the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

In special alloy piping systems, alloy TUBE-TURN Welding Lap Joint Stub Ends permit use of lower-cost carbon-steel flanges as shown in cut-away view.

Special alloys lick special piping problems

Write Dept. A-7 for free booklet "Pipe and Fitting Materials" which gives specifications, properties and welding procedures for various materials.

YOU can overcome special problems of corrosion, fluid contamination, pressure, or temperature by selecting pipe and welding fittings of special materials.

Tube Turns, Inc. continually studies the proper application of different materials to piping systems. The complete line of TUBE-TURN Welding Fittings is available in more than forty different alloys. Today's piping engineer can choose from intermediate and high alloy steels containing chromium, nickel, or both; commercially pure nickel, copper, and aluminum; and alloys of these.

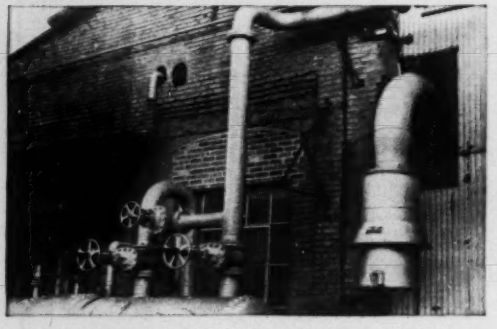
Get in touch with your nearby Tube Turns' Distributor. You'll find one in every principal city.

"Be sure you see the double tt"

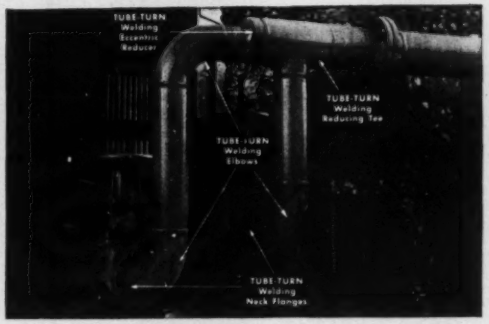
TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles
TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO... A wholly owned subsidiary of TUBE TURNS, INC.

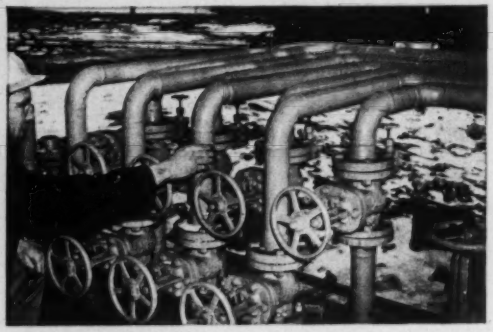
Piping construction simplified by wide range of TUBE-TURN Welding Fittings



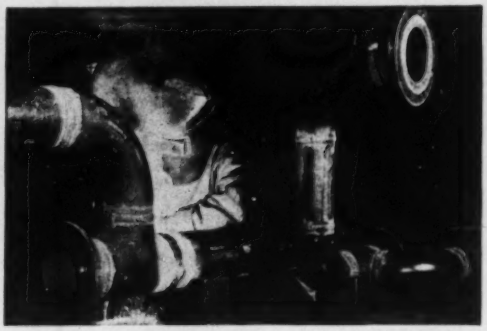
Welding complex process piping calls for a wide variety of fittings and flanges. In this installation, air is drawn into compressor through a 16-inch line, connected to an outdoor filter through a TUBE-TURN Welding Reducer. Air at 100 lbs. is piped to the compressor tank through an 8-inch welded line.



Manifold serves air lines to various shops. Matching the two 8-inch lines to the 12-inch line here was no problem. Use of a TUBE-TURN Reducing Outlet Tee and a TUBE-TURN Eccentric Reducer made the construction job easy. The main line can be opened easily at the TUBE-TURN Welding Flanges.



Small lines tap off fire foam chemical manifold, lead to storage areas and other critical locations. Leakage or weak joints here could be disastrous. Welded piping with strong TUBE-TURN Welding Fittings makes this fire protection reliable.



In fabricating, welders appreciate the true circularity of TUBE-TURN Welding Fittings. To fill an immediate need, a welding elbow is often cut to make an odd-angle welding fitting. Unique forging process assures that TUBE-TURN Welding Elbows can be cut at any angle and still match the pipe for proper welds.

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224 East Broadway • Louisville 1, Kentucky

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Position _____
Company _____
Nature of Business _____
Address _____
City _____ *State* _____

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Philadelphia	Tulsa
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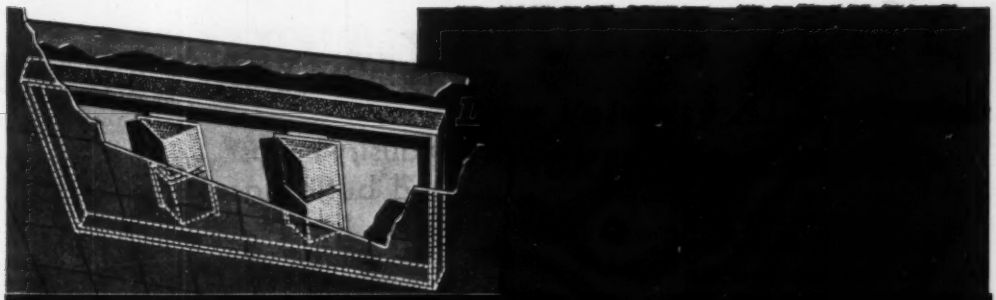
Chicago	Los Angeles

"tt" and "TUBE-TURN" Reg. U.S. Pat. Off.

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY



solve the *really tough* Air Distribution problems in hospitals

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YAKIMA VALLEY MEMORIAL HOSPITAL, Yakima, Wash.
FRESNO COUNTY HOSPITAL, Fresno, California
NEW L.D.S. PRIMARY CHILDREN'S HOSPITAL, Salt Lake City, Utah
CHICAGO STATE T. B. SANATORIUM, Chicago, Illinois
ST. JOSEPH MEMORIAL HOSPITAL, St. Joseph, Mich.
T. B. HOSPITAL, Ohio State University Medical Center
ST. VINCENT'S HOSPITAL, Santa Fe, New Mexico
SAMARITAN HOSPITAL, Ashland, Ohio
NATIONAL INSTITUTE OF HEALTH, Bethesda, Maryland
ROSE MEMORIAL HOSPITAL, Denver, Colorado
ELIZABETH STEEL MAGEE HOSPITAL, Pittsburgh, Penn.
A.E.L. BUILDING #509, U. S. Naval Base Philadelphia, Pa.
BEAR LAKE MEMORIAL HOSPITAL, Montpelier, Idaho
L.D.S. HOSPITAL X-RAY DIVISION, Salt Lake City, Utah
RAVENSWOOD HOSPITAL, Chicago, Illinois
UNIVERSITY HOSPITAL, Omaha, Nebraska
BENSON SWIFT COUNTY HOSPITAL, Benson, Minnesota
SOUTHSIDE HOSPITAL, Bay Shore, L.I., N.Y.
ANOKA T. B. STATE HOSPITAL, Anoka, Minnesota
BINGHAM MEMORIAL HOSPITAL, Blackfoot, Idaho
MOUNT VERNON T. B. HOSPITAL, Mount Vernon, Illinois
PHELPS COUNTY HOSPITAL, Rolla, Missouri
MENOMONIE HOSPITAL, Menomonie, Wisconsin
STATE OF WISCONSIN—GENERAL HOSPITAL, University of Wisconsin
ST. JOSEPH'S HOSPITAL, Hancock, Michigan
IVINSON HOSPITAL, Laramie, Wyoming
BYBERRY STATE HOSPITAL, Tuberculor Patients Building N-10
NEW MOUND PARK HOSPITAL, St. Petersburg, Florida
HEART HOSPITAL, University of Minn., Minneapolis, Minn.
JUAB COUNTY HOSPITAL, Nephi, Utah
SOMERSET STATE HOSPITAL, Somerset, Penn.
GILLETTE HOSPITAL, St. Paul, Minnesota
GADSDEN COUNTY HOSPITAL, Quincy, Florida
UNIVERSITY OF ILLINOIS, PHYSICAL ENVIRONMENT LABORATORY Urbana, Illinois
CHESTNUT HILL HOSPITAL, Philadelphia, Pa.
UNIVERSITY OF CALIFORNIA, Medical School—Teaching Hospital
PASTEUR MEDICAL BUILDING, Oklahoma City, Okla.
OAKWOOD HOSPITAL, Detroit, Michigan
COLEMAN HOSPITAL, Indianapolis, Indiana
STANISLAUS COUNTY HOSPITAL, Modesto, Calif.
UNIVERSITY OF CALIFORNIA, Virus Laboratory

✻ See SWEET'S Arch. & Eng. Files or Write for detailed literature and the name of the Multi-Vent sales engineer in your vicinity.

Psychiatric Wards
Nurseries
Laboratories
Psychometric Rooms

Multi-Vent Ceiling Panels have been specified for the new addition to the UNIVERSITY OF ILLINOIS RESEARCH AND EDUCATIONAL HOSPITALS, Chicago
Architects • Holabird, Root & Burgee, Chicago
Consulting Engineers • E.P. Heckel & Assoc., Chicago

Hospital medical staffs and technicians are rapidly recognizing that the Multi-Vent panel is *the* one air diffuser that can surely meet, even surpass, their rigid air distribution requirements for air conditioning these critical hospital areas.

The success Multi-Vent has achieved in these nurseries, laboratories, operating rooms, etc. of outstanding hospitals throughout the country, is proof of Multi-Vent's ability to provide truly perfect air conditioned comfort in offices, theatres, stores, restaurants and all other types of institutional or commercial buildings . . . where the best in air distribution is desired.

Multi-Vent's unique pressure displacement principle of air distribution is completely free from BLOW or THROW (high velocity injection), the main source of draft hazards . . . thereby eliminating all of the most serious installation, balancing, and adjustment problems inherent in the velocity injection principle upon which all air diffusers except Multi-Vent depend.

IN OLD FORESTER'S KENTUCKY HOME

as in so many of industry's most efficiently operated buildings

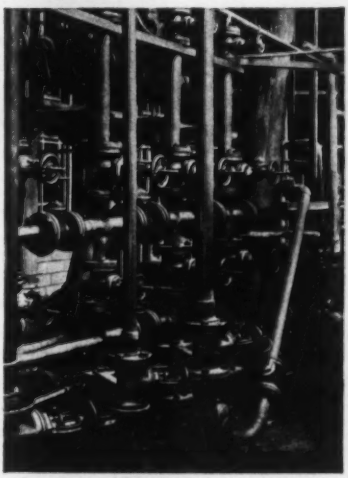
Jenkins Valves
are standard

With science and skill, Brown-Forman Distillers Corporation carries on a famous Kentucky tradition of fine whisky. To insure uniform fineness in the flavor of Old Forester and its other whiskies, nothing is left to chance in the Brown-Forman distilling operations at Louisville.

Equipment for control of production is checked with the same meticulous care as grain samples, before approval. It is significant that Jenkins Valves, standard for years in all Brown-Forman distilleries, were again specified when plant facilities were expanded and modernized recently.

Significant, but not unusual. Jenkins Valves have been the choice *consistently* of the men who plan America's outstanding buildings. Future-minded, these men — architects, engineers, contractors — think of all operating equipment in terms of tomorrow's maintenance costs.

Jenkins builds *extra* endurance into valves — proved by low upkeep cost records in every type of service. Yet, despite this extra value, *you pay no more* for Jenkins Valves. For new installations, for all replacements, let the Jenkins Diamond be your guide to lasting valve economy. Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros., Ltd., Montreal.



Among more than 3500 Jenkins Valves in Brown-Forman's Louisville plant are these which control the flow patterns through quadruple effect evaporators in the By-Products Building

JENKINS VALVES
LOOK FOR THE DIAMOND MARK
SINCE 1864 TRADE JENKINS MARK

SOLD THROUGH LEADING INDUSTRIAL DISTRIBUTORS EVERYWHERE

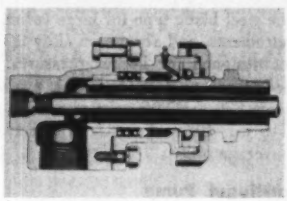
Jenkins Bros

EQUIPMENT DEVELOPMENTS...

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1951 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in your Directory Section; double asterisk, equipment and manufacturer not listed.

Crane Cab Cooler

HPAC 1—The "Split-Type" crane cab cooler, for air conditioning the cabs of cranes operating in high temperatures or in atmospheres contaminated by toxic and noxious gases or dusts, has been developed by Dravo Corp., 5th and Liberty Aves., Pittsburgh 22. Since the cooling section is installed in the cab and the condenser is placed outside on the crane, no ductwork is needed for installation. Power lines and refrigerant piping connect the two sections. The new unit provides year round ventilation—filtering, cooling, and, if necessary, heating. It is thermostatically controlled, and is said by the manufacturer to maintain a temperature of 80 to 85 F at an outside ambient of 175 F. For heating, a temperature of 68 to 75 F is maintained at outside ambient temperature of zero.



Left: Cab Cooler

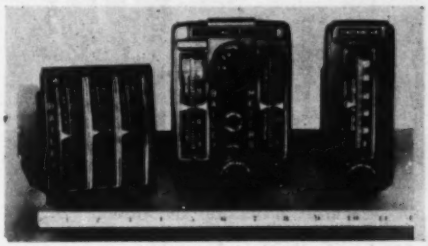
Above: Revolving Joint

Revolving Joint

HPAC 2—The improved type IBR revolving joint, for making piping connections to drum type dryers, rolls, calenders, and other rotating equipment, is now available from Barco Mfg. Co., 1801 Winnemac Ave., Chicago 40. The rotating portion is a steel tube which screws into the hub of the drum or roll. The non-rotating portion is ball bearing mounted on the tube, and the bearings carry the load of both radial and end thrusts. The joints are built for 150 psi, steam, or 200 psi, hydraulic, and also for vacuum service. They are recommended by the manufacturer for speeds up to 500 rpm, steam, or 750 rpm, hydraulic, and temperatures to 450 F, depending on packing specified. Standard sizes range from ½ to 2 in. and body types include both single and siphon or two way flow models with straight and angle connections.

Indicators and Control Units

HPAC 3—The new "Mini-Line" miniature indicators and control units developed by Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, O., are designed to make possible the concentration into a small space all information and controls for operating one or more boilers, turbines, or process units such as cement mills, foundries, etc. The multi-point indicator (at left in photo) is composed of individual vertical scale units nested together in whatever quantities are necessary for comparing a set of related



factors. A three unit indicator is 4¼ in. wide and 4 ¾ in. high. The selector valve (center) is 4½ in. x 6¼ in., and can be used for remote manual or automatic operation of air operated controls. There is no "reset" position needed for changeover, which is instantaneous. The remote manual relay (at right) for factors which do not warrant automatic control, measures 2⅝ x 6¼ in. It is planned to mount these instruments on control panels.

Temperature Regulator

HPAC 4—Fulton Sylphon Div., Robertshaw-Fulton Controls Co., Knoxville, Tenn., has added a new series, the No. 999 temperature regulators, to its line of self-powered con-

FOR YOUR CONVENIENCE [7-51]

Heating, Piping & Air Conditioning
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each HPAC number in which you are interested)

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
101	102	103	104		106	107	108	109	110
111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127		129	130
131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150
151									

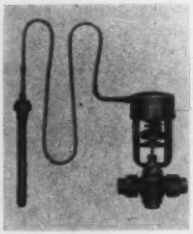
Name ..... Title .....

Company .....

Address .....

City ..... Zone ..... State .....

trols. Press formed, stainless steel frames permit reduction in the weight and height of the units, and are said by the manufacturer to provide minimum heat conduction from the valve to the regulator head. Thermal units contain large, two ply metal bellows. The regulators are available in valve sizes of from ½ to 4 in., and have a temperature range of from 40 to 440 F. Illustrated is the type of bulb used for liquids, but a fin type bulb for air or gases is also available, as are indicating thermometers and other special features. The new series is recommended for controlling the temperatures of internal combustion engines, storage water heaters, bottle washers, slashers, etc., and for various industrial process applications.



Regulator

Relief Valves

Relief Valves in Multiple Assembly

HPAC 5—For large boilers with a gross heat output above 242,900 Btu per hr, McDonnell & Miller, Inc., 3500 N. Spaulding Ave., Chicago 18, is offering assemblies consisting of two or three of its series 33 safety relief valves. The assemblies are designed to provide discharge capacity equal to the gross Btu output of these boilers. The two valve assembly is rated at a discharge capacity of 496,700 Btu per hr; the three valve assembly, at 769,400 Btu per hr. When boiler pressure reaches 30 psi, one valve opens just enough to take care of normal thermal expansion. If excess pressure conditions exist, the two or three valves open in succession for full rated discharge capacity.

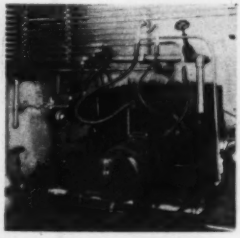
Portable Electric Dehumidifier

HPAC 6—A 56 lb portable electric dehumidifier for commercial use is now being produced by Remington Corp., Auburn, N. Y. This "Moisture Magnet" is said to remove 14 pints of water every 24 hr from room air at 80 F and 79 percent relative humidity, and up to one pint every hour under more severe conditions. It operates on 115 volt, single phase, 60 cycle current.

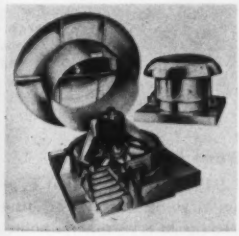
A "Du-Flo" fan draws damp air over the refrigerated coils and condensed moisture drops into an 8 qt receptacle. If desired, drain piping may be installed.

Gas and Oil Burner Combination

HPAC 7—The model GW combination gas and oil burner has been developed by Petroleum Heat and Power Co., Stamford, Conn., for users of natural or mixed gas who need a readily available alternate fuel for commercial or industrial applications. The oil burning side of an installation (shown in illustration) and the gas side operate independently of each other, although the mechanisms are mounted, installed and controlled as one. The changeover, said by the manufacturer to require only 60 seconds, is effected by the shutting off of one side and starting of the other. Designed for use with "cold" No. 5 fuel oil or lighter, and with 1000 Btu natural gas or 800 Btu mixed gas, models are currently available in five sizes which furnish from 3,750,000 to 15,000,000 Btu per hr.



Burner



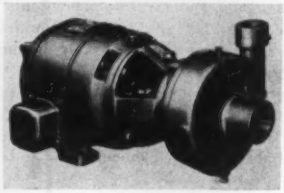
Exhauster

Power Roof Exhauster

HPAC 8—Chicago Blower Corp., 4558 W. Congress St., Chicago 24, has developed an axial mushroom type power exhauster for industrial and commercial roof ventilating applications, and for use as a fresh air supply unit when direction of air flow is reversed. The diffuser head, formed from one piece of heavy gage steel, is said by the manufacturer to reduce turbulence and discharge losses and to meet all blackout requirements. Wheels are available in direct or belt drive. Airfoil section blades are furnished in the steel blade type for large volume and static pressure requirements, and aluminum alloy is used in the two other types designed for higher pressures. Blades can be adjusted to any pitch. The unit is available in air capacities of from 870 to 47,000 cfm and static pressures of from ⅛ to 1½ in. Blade diameters range from 14 to 48 in., and the average unit is 2 ft high.

Centrifugal Pump

HPAC 9—For use in chemical, process, food and other industries, Bell & Gossett Co., Morton Grove, Ill., is offering a small centrifugal pump with all wetted parts of Type 316 stainless steel. The pump is constructed in ¾ in. to ½ in. discharge, and there is a range of from ¼ hp (1750 rpm) to 2 hp (3450 rpm). Also featured are an hydraulically balanced impeller, a spring-type flexible coupling and a leakproof mechanical seal. The unit is said by the manufacturer to be easily serviced, since removal of a few bolts permits separation into three parts.



Above: Pump
Right: Filter

Compressed Air Filter

HPAC 10*—The "Vape-Sorber", a newly developed device of Selas Corp. of America, Philadelphia 34, is

DON'T HEAT THE GROUND UNDER THE BUILDING!

WHERE RADIANT HEATING operates upward from an uninsulated GROUND FLOOR the loss of heat downwards by straight conduction through solids is substantial.

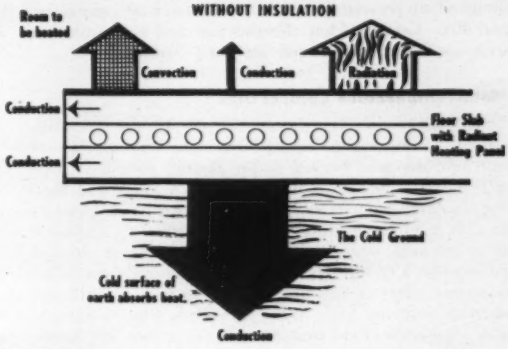
Heat by conduction follows the law that warmth flows to cold, never the reverse; in any direction, down and sideways, as well as up.

Since the ground is colder and more massive than the space above the floor, there will be considerable flow of heat to the earth below as well as the floor above.

The GUIDE of the Amer. Society of Heating and Ventilating Engineers says, *"When the heating pipes are imbedded in a concrete floor slab a portion of the heat emitted by the pipes will flow upward into the space to be heated, and the remainder will flow downward into the ground.*

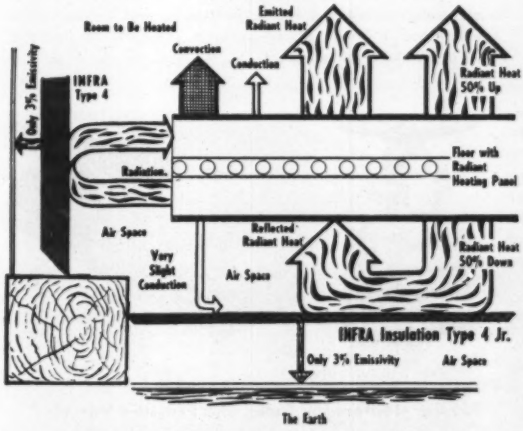
"When the heating pipes are placed below the concrete floor slab instead of being imbedded in the slab, a larger portion of the heat will flow into the ground, and a smaller portion into the space to be heated."

Heat Flow from Floor Radiant Heating Panel
WITHOUT INSULATION



COLD AREA

Heat Flow from Floor Radiant Heating Panel
WITH INFRA INSULATION



INFRA THERMAL FACTORS, DOWNHEAT FLOW

Type 6	C.044 R22.72 equals 9" DRY Rockwool
Type 4	C.065 R15.38 equals 6" DRY Rockwool
Type 4 Jr.*	C.097 R10.30 equals 4 1/3" DRY Rockwool

*In 1" Space

INFRA INSULATION, INC.
10 Murray Street New York, N. Y.

The National Research Council of Canada recently conducted numerous tests and found that without insulation under ground floor radiant panels, heat flow *into* the earth was preponderant; in considerable amounts to 6 ft. underground, and extending in lesser amounts to 12 ft.

By installing multiple accordion aluminum with assured air spaces, under the heating panel, MOST of the dissipated heat would be saved for radiant heating, because 95% of CONDUCTION to the earth would be stopped by the air spaces, and RADIATION loss would be only 3%. There is NO CONVECTION downwards.

Six-space and 4 space multiple accordion aluminum have C factors for downheat flow of .044 and .065 respectively, equal to 9" and 6" laboratory dry rockwool. They are non-condensation forming, of zero vapor permeability.

Insulation in relation to radiant heating, with a new technique for floor slabs, is one of the topics covered in Infra's "Simplified Physics of Vapor and Thermal Insulation," a complete and concise manual mailed free on request.

INFRA INSULATION, INC.
10 Murray Street, New York, N. Y. Dept. H-7
Please send FREE "Simplified Physics of Vapor and Thermal Insulation."

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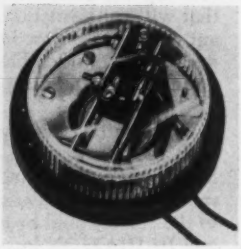
designed to provide continuous removal of petroleum vapor from compressed air and other gases.

It is installed in air or gas lines to instruments and pneumatic operations where "oily air" has detrimental effects. In addition to removing petroleum vapor, it is designed to remove water, free oil, water-oil emulsions, and dirt. Ceramic filter elements are used in conjunction with specially compounded activated carbon.

Mold Temperature Control Unit

HPAC 11—Sterling, Inc., 3738 N. Holton St., Milwaukee, is offering the model 6002 mold temperature control unit, designed for use in the plastics industry. This self-contained device, consisting of two independent heating, cooling, and circulating systems in a single portable unit, is used for heating or cooling water to maintain it at a constant temperature while circulating it through passages in a mold. The large, thermostatically controlled immersion heaters have the capacity to heat up cold dies quickly, maintain high die temperatures when necessary, and supply sufficient heat to very large dies, the manufacturer states. Cooling is effected by use of a modulating valve which holds steady temperatures when operating on a constant cooling load. For circulation, two "Sterlco 4100-B" series vertical centrifugal pumps are used.

Control Unit



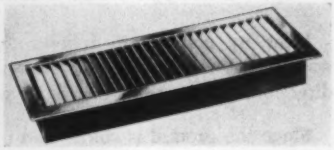
Switch

Pressure Actuated Switch

HPAC 12*—A new pressure actuated switch designed to respond to slight changes in pressure is now being manufactured by F. W. Dwyer Mfg. Co., 317 South Western Ave., Chicago 12. It can be used to indicate pressure drops in air filters, across coils, to indicate power or blower failure or unsafe operating conditions in forced air feed and boiler draft, etc. The slack diaphragm of the unit is linked to a spring which actuates a microswitch. Rated at 10 amp, 110 volt a-c, the microswitch can operate on plus, minus or differential pressures up to 4 in. of water for standard models. The model illustrated has a 4½ in. diameter and a minimum setting of .25 in. water with a gap between the make and break pressures of .20 in. Another model has a 7 in. diameter with a minimum gap between the make and break pressures of .05 in. water in the lower settings, 10 percent or more of the setting in the higher ranges.

Cooling Towers

HPAC 13—Four improved models of cooling towers for use with self contained air conditioning units and in other water cooled refrigeration applications have been developed by Carrier Corp., Syracuse, N. Y. The units feature a built in, two bend eliminator blade section said by the manufacturer to minimize overspray. Since a water turbine drive is used for the fan and spray system, no electrical connections are needed. Turbine bearings are supported on a film of water with no metal-to-metal contact, and fill material is asphalt impregnated board. The models are designed for 5, 7½, 10 and 15 hp air conditioning systems.



Above: Register

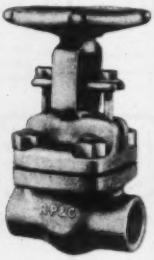
Left: Cooling Tower

Perimeter Register

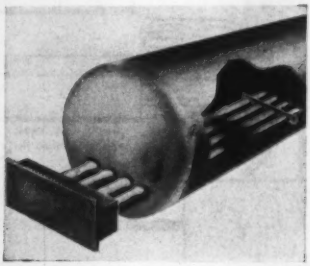
HPAC 14—Air Control Products, Inc., Coopersville, Mich., has developed a long, narrow perimeter diffuser which gives a flat air pattern for blanketing large windows and cold outside walls with warm air. Vanes can be adjusted for any desired air pattern. Units are available in four sizes 4 x 10, 4 x 12, 4 x 14 and 2¼ x 14. There is an adjustable damper for balancing heating systems.

Forged Steel Gate Valves

HPAC 15—The forged steel gate valve developed by R-P & C Valve Div., American Chain & Cable Co., Inc., Reading, Pa., has a bolted bonnet, said by the manufacturer to insure maximum service life and low cost maintenance; a tongue and groove joint with soft iron gasket; and extra hard wedge facing. Stainless steel gland bolts and nuts prevent freezing or corrosion, and the two piece gland and follower apply uniform pressure on packing. It is available in sizes of ¼, ⅜, ½, ¾, 1, 1¼, 1½, and 2 in.



Gate Valve



Heater

Tubular Heaters for Tanks and Pressure Vessels

HPAC 16—A new line of tubular heaters designed to provide low density electric heat for oils, tars, resins and other viscous fluids, is now being offered by the Hynes Div., Martin-Quaid Co., 1802 Sedgley Ave., Philadelphia 6. The manufacturer states that the new heaters eliminate carbonization and other forms of fluid breakdown result-

[*Continued on page* 197]

Controlled Ventilation... at Hales Bar Dam

Photo courtesy Tennessee Valley Authority

It used to be mighty uncomfortable in the generator room of the hydro plant at Hales Bar, on the Tennessee River. In this old plant, purchased by TVA, hot weather temperatures often soared above 120°, and the 14 air-cooled generators could not operate at full capacity. To beat the heat, TVA engineers installed 32 DeBothezat 36″ Power-Flow Roof Ventilators which pull in a total of 400,000 cubic feet of cool air every minute. Result? Greatly improved working conditions for the men, and increased power output from the generators.

LOW, STREAMLINED DESIGN

DeBothezat Power-Flow Roof Ventilator is a motor-driven fan in a weatherproof housing, for use with or without duct systems. Power-Flow Roof Ventilators can be used either for air exhaust or intake and are available with fan wheels 12″ through 48″ in diameter, delivering up to 40,900 CFM. For catalog containing illustrations, specifications and certified capacity ratings, write our factory, Dept. HP-750, or phone your local DeBothezat agent.

Certified Ratings

PFMA

Power-Flow

LIGHT-PROOF AT NIGHT
to comply with possible blackout regulations

Steel saved civilization at Augsburg

FOR 2000 years, the western world has survived vast waves of Asiatic invaders who threatened to destroy it. Repeatedly, the fate of civilization and Christianity has seemed to hang on the outcome of a single battle.

Such a decisive action was fought at Augsburg, South Germany, in 955 A.D. Swarming out of Asia, savage Magyars overran the rich Danube Valley. They ravaged the prosperous lands of Germany, Italy and France. At last, under Otto, King of Saxony, the armored Knights of Christendom rallied. They faced a hundred thousand fierce foes. The battle raged all day. Thousands were slain. At last the tide turned and the Magyars fled. For three days the Knights pursued the scattered enemy, killing or capturing thousands more. Symbolic of the west's predominance in weapons and armor of iron and steel, victory was credited to King Otto's iron-tipped Holy Lance.

Augsburg ended the Magyars' attempts to conquer Europe. They settled down to peaceful living in their valley and within 50 years accepted Christianity. Again, history demonstrated the truism that no people or alliance can establish supremacy unless it first predominates in the production and use of iron and steel.

It is reassuring that America produces twice as much steel as the rest of the world combined. America has the steel to win. We will use enough of it to protect our leadership of a free Christian world.

Scrap Metal is Critical Again

The Youngstown Sheet and Tube Company

General Offices—Youngstown 1, Ohio

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MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

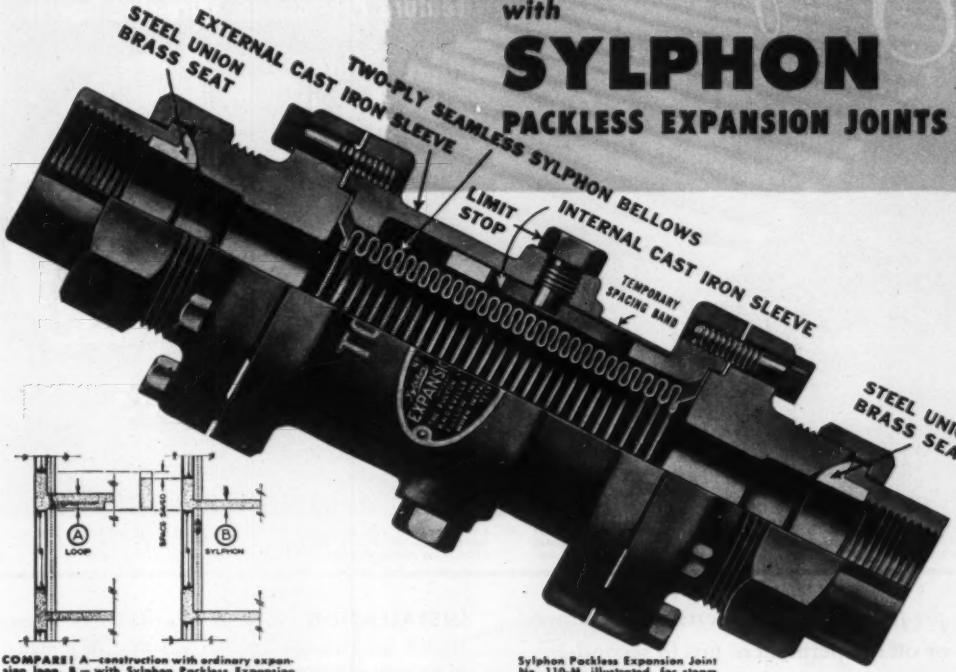
The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment

Raise the ceiling on rentable space—lower heating costs!

with

SYLPHON

PACKLESS EXPANSION JOINTS



COMPARE! A—construction with ordinary expansion loop. B—with Sylphon Packless Expansion Joint. Floor depth A is approximately twice the thickness of B. Corresponding difference in window space. Ceiling at B unbroken, better appearance. Space saved can mean an extra story.

Sylphon Packless Expansion Joint No. 110-M, illustrated, for steam heating lines. (No. 111-M, not shown, for hot water service.)

Sylphon Packless Expansion Joints make important savings!

THEY INCREASE RENTABLE SPACE when used in place of expansion loops—by eliminating useless building height. They help save construction costs and materials.

THEY LOWER HEATING COSTS, because they assure a continuous sealed piping system. No wasteful leaks and costly repacking. Steam or hot water is distributed with greatest economy of space, and with a substantial cut in heating costs.

COMPACT—few component parts. Rugged and dependable, built for long, trouble-free service. Thousands in use. For complete information, send for Catalog NH-65.

Temperature Controls • Bellows Devices • Bellows Assemblies

FULTON SYLPHON
DIVISION

FIRST WITH BELLOWS

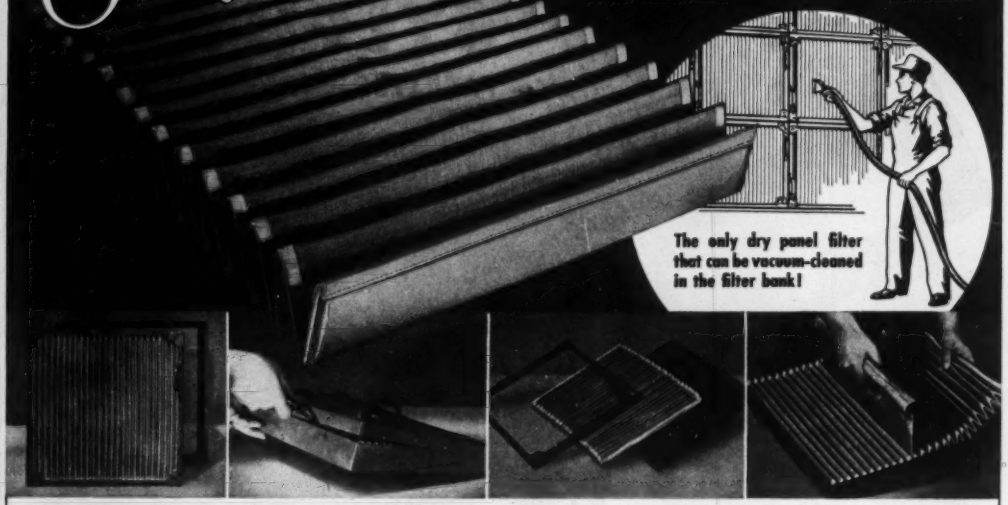
ROBERTSHAW-FULTON CONTROLS CO., KNOXVILLE 4, TENN.

Canadian Representatives, Darling Brothers, Montreal

UNSURPASSED IN EFFICIENCY • ECONOMY • VERSATILITY

Staynew DRY PANEL FILTERS

Feature Pre-formed, Wire-clad Inserts



Cell removed from frame by sturdy offset handles after releasing locking cams.

Removing pre-formed Insert is simple. Snap catches are released, cover lifted off, Insert lifted out.

Dis-assembled cell showing removable cover, Insert and box containing permanent fin support.

Insert easily slipped on permanent fin support by means of special Staynew Loading Knife.

. . . *pre-formed* so that Inserts can be slipped on or off the permanent fins in seconds! . . . *wire-clad* for complete protection of medium and maximum fire resistance! . . . *Class I Underwriters' Approval* in bonded glass!

FIN CONSTRUCTION provides the greatest possible filtering area in available space. Resistance in relation to dust load is less than in panel filters built on any other principle.

OPERATING ECONOMY is amazing. The most fragile medium can be cleaned repeatedly either by vacuum or fluid (dry-cleaning). Insert replacement cost is very low.

STAYNEW DRY PANEL FILTERS are *versatile* . . . utilizing any medium in sheet form that can be crimped. Stock media include wool felt, rayon-cotton-wool felt, bonded glass, and Feltex. The latter is a surprisingly low cost, highly efficient medium.

INSTALLATION can be in flat or V-banks, frames riveted but individual cells removable in a matter of seconds. All standard sizes are available in 2″, 4″ and 8″ depths.

FOR EVERY DRY PANEL NEED there is a Staynew model and medium for maximum efficiency at minimum cost.

WRITE FOR BULLETIN DPF

Representatives in Principal Cities

DOLLINGER CORPORATION

9 CENTRE PK., ROCHESTER 3, N. Y.

DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

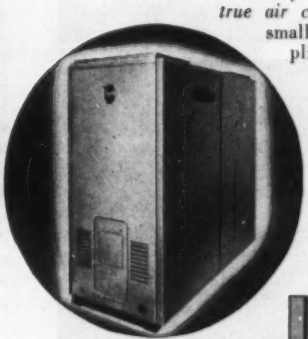
Now you can do something about the weather

This is how you can help your client obtain *complete* comfort indoors, day and night, through *all* the seasons.

Install Bryant *All-Weather Conditioning* for refreshing summer cooling . . . automatic gas heating in winter . . . stimulating air circulation all the year . . . and *independent, automatic control of humidity* that eliminates that cold, "clammy" feeling.

The Bryant *All-Weather Conditioner* is designed for ease of installation and maintenance. All basic equipment and controls are concealed within a single, compact steel jacket. Cooling system, using safe, odorless Freon F-12, meets all code requirements. *Hevigage* Heat Exchanger and built-in draft diverter of heating component are porcelain-enameled for extra long life. *Five* different safety devices throughout the unit provide complete protection.

It's Bryant *All-Weather Conditioning* for *true air conditioning* in residences and small commercial buildings. For application data and specifications, contact the Bryant Distributor in your locality or write direct. Bryant Heater Division, Dept. 156, Affiliated Gas Equipment, Inc., 17825 St. Clair Ave., Cleveland 10, Ohio.



Bryant Model 576 All-Weather Conditioner. Made in 1½, 3 and 5-ton cooling capacities. Gas heating inputs from 100,000 to 200,000 Btu per hour, for use with all gases.

Let the pup be weatherman

bryant

ALL-WEATHER CONDITIONING

Your *single source* of supply for everything in gas heating equipment!

Tyrone, Pa.

Charleston, S. C.

Luke, Maryland

in all these plants of

WEST VIRGINIA PULP & PAPER Co.

Fine papers for almost every purpose—papers that add their persuasive influence to the printed word, beauty to packages and ruggedness for protection; these are West Virginia's products. The Ohio Injector Company considers it a compliment that OIC Valves share in their production.

OIC Valves are *precision engineered* and *precision built,* providing efficient control of flow of air, gases and liquids. And where plant designers and builders need assistance in selecting valves best suited to each use, OIC engineers offer *precision application* help.

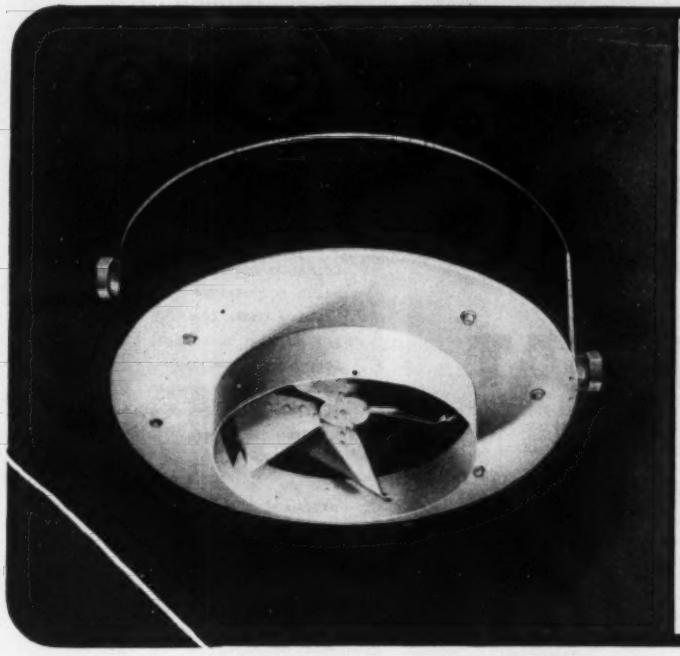
Ask your local OIC distributor for a free copy of the OIC Valve Cross-Reference Chart. Or write direct to The Ohio Injector Company, Wadsworth, O.

OIC
FOUNDED 1881

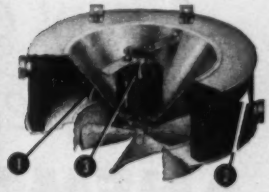
VALVES

FORGED AND CAST STEEL · IRON · BRONZE

new dunham unit heaters



dunham design features you'll want to see



1. **sturdy motor support cone** protects motor from excessive heat, dust and other impurities.

2. **improved header design** requires fewer solder joints; assures uniform steam distribution; eliminates air pockets.

3. **resilient motor mounting** insulates motor vibrations, avoids transmission of noises through piping.

throw heat where you want it
assure quieter operation
save on installation expense

You're looking at . . . and into . . . Dunham's new Vertical Discharge Unit Heater. Designed inside and out to assure continued delivery of original rated capacities, these new heaters can maintain perfect balance between air volume, velocity, and final outlet temperatures. They keep customers comfortable and contented because they:

throw heat where needed—Motor support cone effectively funnels air from heating element to propeller fan; selection of air diffusers assures proper directional control of heat throw.

assure quieter operation—Motors are rubber mounted to minimize vibration and noise. Correctly pitched fan blades operate at relatively slow speed for quiet operation.

save on installation expense—Supply and return tappings located on sides of heater for simplified horizontal piping hook-up. Fewer fittings required.

Here are the Facts

If you are engaged in defense or essential civilian production, it will be to your advantage to know more about these heaters. Bulletin 1301-2 contains complete information. Write for your free copy.

DUNHAM

C. A. DUNHAM COMPANY
400 W. Madison Street, Chicago 6, Illinois
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heating systems and equipment

Vari-Vac Differential Heating • Fin-Vector Radiation • Convector Radiation
Baseboard Radiation • Vacuum Pumps • Condensation Pumps • Horizontal Heaters • Cabinet Heaters • Traps • Valves

They all depend on

ANEMOSTAT

FOR DRAFTLESS AIR DIFFUSION

"Judge a product by those who use it." Apply this maxim to air diffusers and you have ample evidence why Anemostat Draftless Air Diffusers enjoy such overwhelming preference. This partial list of "those who use it" proves the point.

Many of these installations represented unique air diffusion problems which were successfully solved by Anemostat. This experience can be a valuable and practical aid to you. Your local Anemostat Sales Engineer is backed by the most experienced engineering department in the air diffusion industry. Call him.

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AMERICAN CAR AND FOUNDRY COMPANY
AMERICAN CYANAMID COMPANY
B & O RAILROAD
BETHLEHEM STEEL COMPANY
BOEING AIRCRAFT COMPANY
BURDINE'S DEPARTMENT STORE
CHASE NATIONAL BANK
CHRYSLER CORPORATION
COLUMBIA BROADCASTING COMPANY
CONSOLIDATED VULTEE AIRCRAFT CORPORATION
CONTAINER CORPORATION OF AMERICA
DRAVO CORPORATION
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JANTZEN KNITTING MILLS
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LIGGETT & MYERS TOBACCO COMPANY
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ANEMOSTAT CORPORATION OF AMERICA
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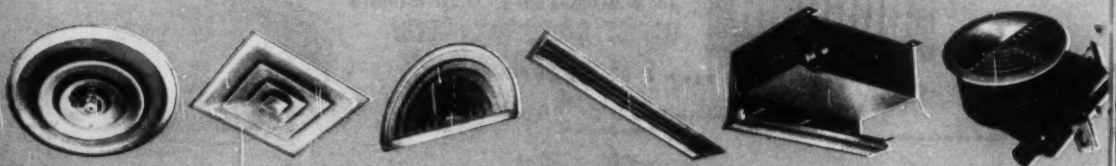
REPRESENTATIVES IN PRINCIPAL CITIES

"No air conditioning system is better than its air distribution"

★ **ONLY ANEMOSTAT OFFERS ALL THESE TYPES OF AIR DIFFUSERS TO FILL EVERY ARCHITECTURAL AND ENGINEERING NEED**



Round | Square | Semi-circular | Straight Line | Straight Line High Velocity | Round High Velocity

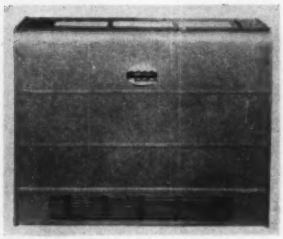
AC-1300

[*Continued from page* 188]

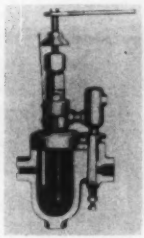
ing from local overheating, since the design permits large input capacity without exceeding the heat density limitations of the fluid treated. Heaters are installed without liquid joints, and the internal heating elements can be removed from tube enclosures without draining fluid from the vessel. The heaters can be adapted to various total input capacity and heat density needs through different combinations of tube and element assemblies. Moisture-proof or explosionproof models are available.

Convector

HPAC 17*—The new "Flow-Cold" convector of Acme Industries, Inc., Jackson, Mich., is designed for use with the company's summer conditioning units, or with heat pump and boiler systems for year round conditioning. It is available for floor, wall or ceiling installation, and features three speed control and slow speed blowers for quiet operation. Units are 11½ in. wide and 25¼ in. high, and come in lengths of 30, 38 and 62 in. With 46 F water on at medium speed, cooling capacities are 7,200 Btu per hr for the shortest model, 12,000 for the next, and 18,000 for the longest. Heating capacities for the three sizes, at 180 F water on and medium speed, are 15,700, 26,500 and 39,000 Btu per hr.



Convector



Valve

Valve for Continuous Boiler Blowdown

HPAC 18—The new "K-Master" valve for maintaining correct boiler water concentration through continuous boiler blowdown has been introduced by Kaye & MacDonald, Inc., 15 Central Ave., West Orange, N. J. The manufacturer states that the new valve prevents severe flashing conditions, plugged valve ports, valve and seat erosion, plugged pipe lines, and other maintenance problems. The assembly can be dismantled for servicing of the valve, valve seat, restricted orifice and strainer, by the removal of two nuts. Flow rate can be adjusted through a wide range. Bodies for 250 psi valves are semi-steel with stainless steel trim, standard tapped for ½ in. or ¾ in. pipe. For higher pressures, bodies are all steel with stainless steel trim.

Coated Welding Fittings and Joint

HPAC 19**—Welstrom, 5th St. and N. Ford Blvd., Hamilton, Ohio, has developed welding fittings and joints for use with internally coated, corrosion resistant piping systems (chemical industry piping, steam return condensate lines, etc.). The fittings are said to eliminate tur-

...A-C or D-C... multi-pole construction... many more uses

Now you can get fast, positive, consistent operation on a *wide range* of load and control circuits... from the finest design of solenoid contactor on the market.

This new Size O a-c contactor brings Ward Leonard's line of solenoid contactors into the 15 ampere range. And it comes with as many as 5 poles. Double-break silver contacts may be interchanged to form normally-open or normally-closed contacts as desired.

Operating coils are interchangeable with Size 1 contactor coils. Available also with d-c "power plants".

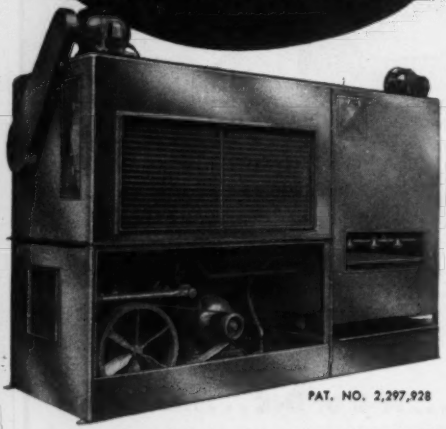
Write for Bulletin 4458. WARD LEONARD ELECTRIC CO., 24 South Street, Mount Vernon, N.Y. Offices in principal cities of U. S. and Canada.

WARD LEONARD ELECTRIC COMPANY

Result-Engineered Controls Since 1892

RESISTORS • RHEOSTATS • RELAYS • CONTROL DEVICES

For day in, day out
DEPENDABILITY
you can't beat a
GOVERNAIR
COMPLETELY PACKAGED
AIR CONDITIONER



PAT. NO. 2,297,928

Name your job . . . any air conditioning job requiring from 3 to 50 tons . . . and you'll find that you can't beat a Governair system for day in, day out dependability.

Governair Packaged Air Conditioners are designed to operate at peak efficiency—with all parts precision-matched to work together. And they're built to give years and years of low-cost, trouble-free service.

Choose Governair . . . and you choose the best!

AIR CONDITIONERS | EVAPORATIVE CONDENSERS | COOLING TOWERS | UNIT COOLERS | BLAST COILS FOR HEATING AND COOLING

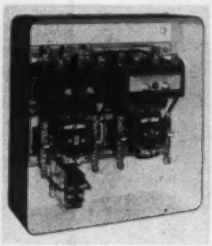
GOVERNAIR

bulence caused failures, since they have an ID identical with that of the pipe. Fittings are available in all standard sizes and types of welding fittings, and joints are offered in from ½ in. to 30 in. diameters.

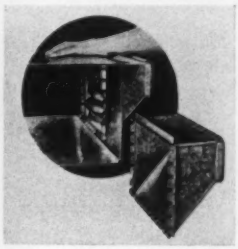
A typical fitting has three parts, an internal sleeve and two external fittings. Joint fittings are welded to the pipe ends and both are then coated with a resistant type coating. The sleeve is inserted into the fittings which are then butted together and field welded. The ½ in. of coating destroyed on either side by the welding is replaced by application of cold setting coating on the outside, and introduction of cold setting compound into the interior through a threaded opening in the fitting. The opening is then sealed with a pipe plug, and the interiors of the pipe and fittings are flush.

Part Winding Starter

HPAC 20—Allen-Bradley Co., Milwaukee, Wis., has developed an a-c part winding starter, Bulletin 736, for use with motors which employ two separate parallel windings, star or delta, to obtain increment starting. The unit consists of two across-the-line starters, one of which closes immediately when the start button is pressed. A timing mechanism energizes the second starter after a few seconds, and full line current is supplied to the motor through both windings, each using 50 percent of total current drawn.



Starter



Edges

Pre-Notched Edges for Warm Air Fittings

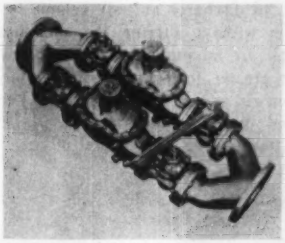
HPAC 21—A pre-notched edge for galvanized fittings with collars is now available from Adelta Mfg. Co., Inc., 21st & Ellsworth Sts., Philadelphia 46, Pa. The edges are closed by finger pressure. All notches are die cut in a U shape and corners are rounded to protect the installer against finger injury. Pre-notching is provided on all four sides of every unit with collar edges.

U-Tile Pipe Conduit

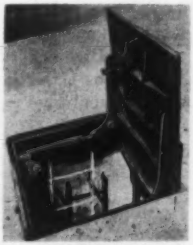
HPAC 22—A new U-tile type conduit for one pipe installations or installations having several small pipes is now available from Porter-Hayden Companies, 825 Frelinghuysen Ave., Newark 5, N. J. U-tiles are shipped to the job as flattened cylinders, scored longitudinally on both of the flattened sides. They split into two U tiles when each scoring is tapped with a hammer. A circumferential scoring at one end of each tile, when chipped off, provides a rough-edged bevel which permits the jointing mortar to key and bond into the channels formed within the tile sections. This makes possible tight, flush joints which can be sealed with asphalt waterproofing mastic.

Compound Meter Manifold Unit

HPAC 23**—Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh, Pa., has introduced a compound meter manifold unit consisting of two "Pittsburgh-Empire" single register compound meters combined with four "Nordstrom" lubricated plug valves and two 8 in. reducing manifolds, so arranged that for maintenance (meter exchange, check-testing, etc.) one side may be shut down while flow continues through the other passage. Flow capacity for the assembly is 1600 gpm. The battery can be handled as a complete assembly or broken down into sections, the heaviest of which is 170 lb.



Meter Manifold



Vault Cover

Vault or Manhole Cover

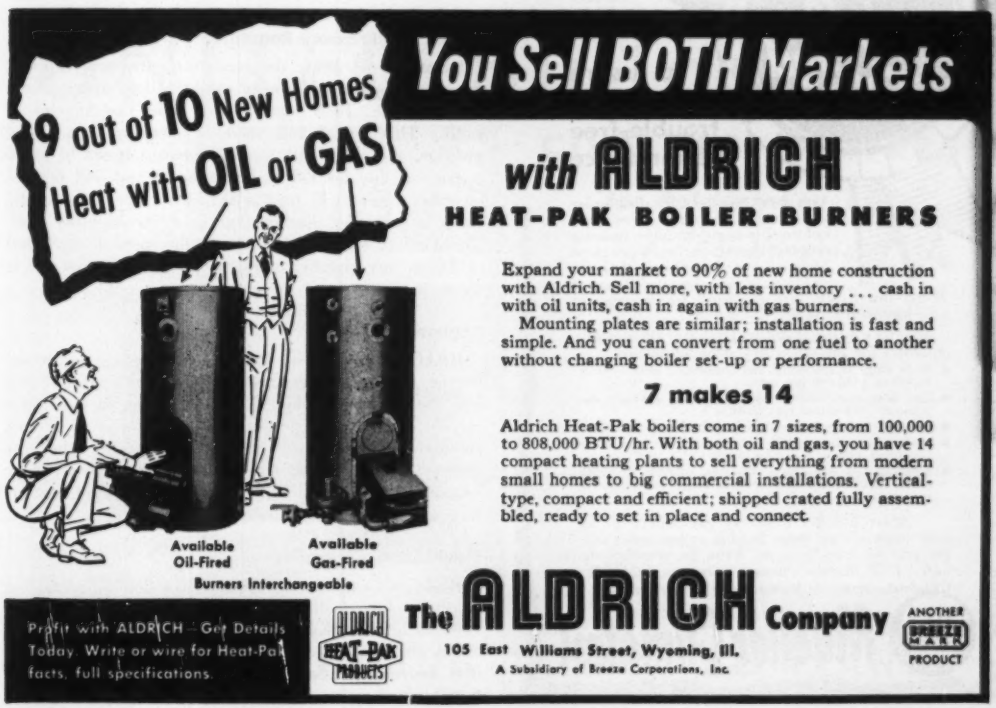
HPAC 24—E. H. Wachs Co., 1527 N. Dayton St., Chicago 22, is manufacturing a counterbalanced cover for valve, meter, transformer, district governor, or other underground vaults, featuring counterweights which ease the load to permit one handed lifting, and which hold the cover in a protective upright position. The cover, which has a tamperproof lock, is opened by insertion of a combination key and handle. There is a 30 sq in. opening, and the counterbalance structure protrudes less than 6 in. from the wall.

Multiple Accordion Aluminum Insulation

HPAC 25—Several new items have been added to the line of multiple accordion aluminum insulation produced by Infra Insulation, Inc., 10 Murray St., New York, N. Y. The Type 6 (six full reflective surfaces and six spaces), Type 4 and Type 2 insulation are now offered for 12 in. centers, and "Retardive" insulation is available for 8, 16 and 24 in. centers. For in-between widths, one or more of the accordion pleats can be folded over to make the insulation narrower, or, for greater width, pieces may be stapled together. In addition, Type 4 insulation for 16 in. centers is now being made in one piece, 1000 ft sq. (750 lineal ft). Type 6 insulation is offered in 24 in. size for wider spacing of building units, and is used in ceilings and roof spaces.

Tube Cleaner for Heat Exchangers

HPAC 26—A straight tube cleaner (air driven, rotary shaft drill type) for process and refinery heat exchangers has been developed by Thomas C. Wilson, Inc., 21-11 44th Ave., Long Island City 1, N. Y. This model TP-301 cleaner weighs 15 lb and is 13 in. long. It provides from 3/8 in. to 2-1/2 or 3 in. OD tube capacity. Hollow shafting is available in one piece up to 20 ft, or in sectional threaded


You Sell BOTH Markets
9 out of 10 New Homes Heat with OIL or GAS
with ALDRICH
HEAT-PAK BOILER-BURNERS
Expand your market to 90% of new home construction with Aldrich. Sell more, with less inventory . . . cash in with oil units, cash in again with gas burners.
Mounting plates are similar; installation is fast and simple. And you can convert from one fuel to another without changing boiler set-up or performance.
7 makes 14
Aldrich Heat-Pak boilers come in 7 sizes, from 100,000 to 808,000 BTU/hr. With both oil and gas, you have 14 compact heating plants to sell everything from modern small homes to big commercial installations. Vertical-type, compact and efficient; shipped crated fully assembled, ready to set in place and connect.
Available Oil-Fired
Available Gas-Fired
Burners Interchangeable
Profit with ALDRICH — Get Details Today. Write or wire for Heat-Pak facts, full specifications.
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Mueller Climatrol Gas Boilers Must be Good!

Type 20 Gas Boiler —from 315,000 to 3,780,000 Btu for steam and hot water.

They're Triple Tested

to assure continued, trouble-free performance

Yes, every Mueller Climatrol boiler is hydrostatically *tested three times* before shipment—at three separate stages of manufacturing. When these boilers leave the factory, they are right! No wonder Mueller Climatrol Boiler installations are renowned for trouble-free operation and long life.

Mueller's sectional design gives you close-to-size capacities for any job; check these advantages:

- Wide range of residential and commercial sizes — from 54,000 to 3,780,000 Btu input.
- Cast iron, sectional. Precision-machined gas-tight flue passages. Maximum heat transfer.
- Patented V-venturi; cast-iron burners; easily accessible.
- Modern, attractive styling. Easily cleaned through access panel without removing casing.
- American Gas Association approved; conform to ASME Code. Backed by 26 years gas boiler manufacturing experience.

Choose Mueller Climatrol gas boilers for all your steam or hot water heating or hot water supply jobs — it really pays. Write for complete details. *L. J. Mueller Furnace Company, 2023H W. Oklahoma Avenue, Milwaukee 15, Wisconsin.*

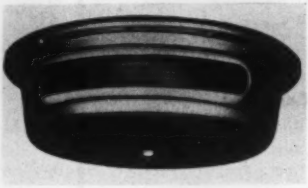
94th Anniversary

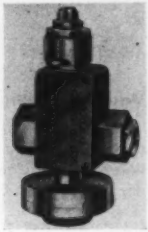
Mueller Climatrol

lengths. Minimum practical working headroom is 5 ft. This tool scavenges the tube with air or water while cleaning. It operates on air pressure as low as 50 lb, the manufacturer states.

High Pressure Air Diffuser

HPAC 27—The new "Kno-Draft" high pressure diffuser, type HPC II, has been developed by W. B. Connor Engineering Corp., Shelter Rock Lane, Danbury, Conn. The manufacturer states that the unit handles air up to 3000 fpm, 2 in. static pressure in ducts, and supply air 25 percent colder than room air. Decibel rating at this pressure is 50. The unit may be adjusted, by an externally operated sleeve damper, to discharge any air volume between 90 and 180 cfm without altering the diffusion pattern. High induction air mixing results in draftless distribution, permitting greater temperature differentials between supply and room air, says the manufacturer. The unit uses small exposed ducts of uniform size. It is recommended for department stores and general offices.





Above: Diffuser
Right: Regulator

Steam and Pressure Regulator

HPAC 28—A newly designed steam-pressure regulator for oil fired burners is being produced by Superior Controls Co., Inc., 1835 South Bonnie Brae, Los Angeles, 6. Calif. This type L-25R valve is normally in a closed position, and opens with steam pressure. It can be set to operate at any desired boiler pressure, and will operate on either a gravity or pressurized fuel system. The needle valve is precision machined of brass or stainless steel. The standard $\frac{1}{8}$ in. orifice may be increased or decreased to deliver any quantity of fuel desired. Inlet pipe size is $\frac{1}{2}$ in., outlet, $\frac{1}{4}$ in.

Registers

HPAC 29**—A new 1951 line of registers with improved closure is now being offered by Krauser-Boyd, Inc., North Tonawanda, N. Y. According to the manufacturer, the closure permits convenient control of heat volume and a tight seal of the duct opening when the register is not in use. Registers come in heavy gage enameled steel, with a grille that provides directional air flow and conceals the interior.

Liquid Level Controller

HPAC 30*—The new "Climax Type 888" displacement liquid level controller of Black, Sivalls & Bryson, Inc., 7500 E. 12th St., Kansas City 3, Mo., is designed for external mounting on vessels, kettles, receivers, etc., where it is desired that the controller be isolated to avoid shutting down of main systems when repair or adjustments are

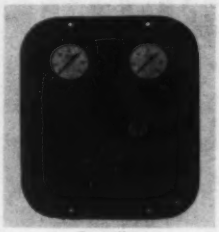
necessary. Utilizing torsion tube assembly for transmitting level changes, the control eliminates packing glands and pressure type bearings.

Anti-Corrosive for Boilers and Metal

HPAC 31**—"Corrosanti," an anti-corrosive for boiler and metal protection, is being offered for national distribution by the research laboratory of Dr. Adolph Schror, 52 Cambridge St., East Orange, N. J. It is manufactured in four grades. One grade, which seals the pores in boiler metal surfaces, removes scale deposits and prevents rust, pitting and corrosion. For removing scale from high pressure boilers, a pint to a quart per boiler per day is injected through the feed line until five gallons are used. After the boiler is clean, one pint every second day is sufficient. Another grade is a rust inhibitor for ferrous metals subjected to water and water vapor, and a third protects metal surfaces subjected to acid and other corrosive vapors, gases, acid forming conditions, brines, etc. The fourth is designed for ferrous surfaces, such as boiler fronts, subjected to temperatures up to 900 F.

Temperature-Pressure Controller with Lock

HPAC 32—Tagliabue Instruments Div., Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J., has incorporated a lock on the cover of its "TAG" non-indicating temperature-pressure controller. In the new model (No. 8352, Type 1) the control setting mechanism is a spindle with a slotted tip placed behind the locked cover. Adjustment of the control is made by unlocking and removing the cover, inserting a screw driver in the spindle slot, and turning in the desired direction. The case cover is then replaced and locked.



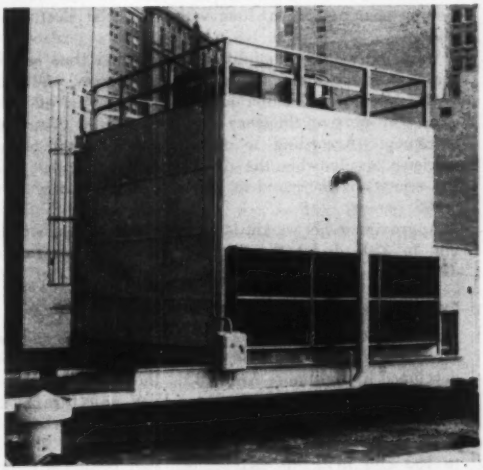
Controller

Humidifier

Humidifier

HPAC 33—The new "Hum-O-Zone" model 300-B humidifier of Daffin Mfg. Co., Lancaster, Pa., has an atomization capacity a third greater than that of the previous model. The new unit, measuring 22 in. by 26 in. wide by 42 in. high, is said by the manufacturer to discharge approximately 1200 cfm of air. The water, atomized in the upper chamber, passes into the air by a method of compartment separation and siphoning, which eliminates the need for the conventional type baffle arrangement. The humidifier is fully adjustable, and is

UNITED Builds A COMPLETE LINE OF COOLING TOWERS for Refrigeration and Air Conditioning



450 ton United Tower in commercial air conditioning service. Transite sheathed; deck filled; low pressure sprinkler distribution.

Individually designed and constructed mechanical draft equipment in any required capacity.

Standardized, prefabricated, easily assembled "package" type spray towers for 5 to 30 tons refrigeration.

Bulletin No. 50 shows typical United installations in all fields . . . power, oil, gas and refrigeration . . . gives full details of design and construction features. Write for it today.

UNITED COOLING TOWER COMPANY

Porter Bldg. Authorized Representatives in Principal Cities Kansas City 2, Missouri

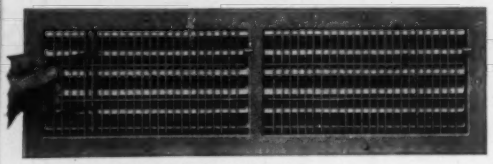
You can get
DIRECTED AIR FLOW
at any angle with

INDEPENDENT
"Fabrikated"
AIR CONDITIONING
REGISTERS

321-A HMV

Rear View Showing "HMV" Valves

Every grille bar adjustable individually—before or after installation



321-A HMV Tandem

Any direction of air flow—right, left, up, down and any combination—is easily obtained with "Fabrikated" Style No. 321-A HMV air conditioning registers, for residence or commercial installations, on sidewalls or ceiling. The face bars are adjustable to right or left; valves on the back are adjustable to direct the air flow up or down; valves may also be fully closed, and are connected to open or close in unison.

The angles of deflection and the combinations to be had are practically unlimited. Adjustments for directed air flow may be made before or after installation. Grille bars are held firmly in place and will not vibrate or rattle.

"Fabrikated" registers are available in sizes from 8 x 4″ to 48 x 24″, including tandem style. Special sizes can be made without special die set-up charges.

Write for Catalog No. 50.

Always Leading—Always Progressing

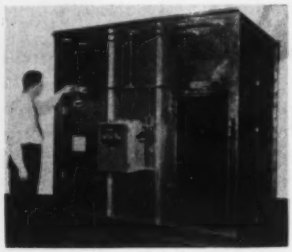
THE INDEPENDENT
REGISTER CO.
3747 E. 93rd STREET · CLEVELAND, OHIO

powered by a 1/3 hp motor. It requires a cold water supply and a 110 volt a-c current for operation in most installations. Tank capacity is controlled by a float, so that no water drain is necessary.

Packaged Air Conditioners

HPAC 34—The improved line of "Weathermaker" packaged air conditioning units in 3, 5, 7½, 10 and 15 hp sizes is now offered by Carrier Corp., Syracuse, N. Y., for use in stores, markets, restaurants, offices, etc. Controls have been simplified so that a single one operates the "Humitrol" on each of the models. All models are now adaptable to either plenum or duct air distribution and heavier hp fan motors have been provided on the two large units to handle higher static pressures of duct distribution systems. A new drive assembly for increased fan speeds is an optional feature on the 10 and 15 hp models. Cabinets have been changed from beige to surf green. Models have an enclosed direct-drive arrangement of motor and compressor.

Conditioner



Air Cleaner

Electrostatic Air Cleaner

HPAC 35—The new type PE encased "Precipitron" of Westinghouse Electric Corp., Sturtevant Div., 200 Readville St., Boston 36; is an electrostatic air cleaner which resembles a factory-fabricated section of air duct or plenum chamber 96 in. long with a built-in electrostatic cleaner.

Designed to assure minimum installation time and expense with maximum air cleaning efficiency, units are available in air cleaning capacities ranging from 8330 cfm at 90 percent efficiency to 44,000 cfm at 85 percent efficiency. According to the company, a 90 percent efficiency results when the air velocity is 333 fpm. When the velocity is increased to 400 fpm the efficiency drops to 85 percent.

Approximate net weight is from 1970 lb for the smallest unit to 4800 lb for the largest size. Units are shipped disassembled.

Evaporative Condensers; Cooling Towers

HPAC 36—The new model P evaporative condenser (shown in photo) and model PT cooling tower have been developed by Baltimore Aircoil Co., Inc., 2519-23 Pennsylvania Ave., Baltimore 17, Md. Both units are of the vertical propeller fan type and are designed for outdoor installation only. Sizes are 3, 5, 7½, 10 and from 10 to 100 tons in 5 ton increments. Fan motors are dripproof, with special insulation suitable for outdoor installation. Standard motors are wound for 220 or 440 volts, 3 phase 60 cycle current.

Monodrives for the fan and pump are standard on all

sizes of the condenser, and on sizes through 50 tons for the cooling tower. Pumps are not provided for the larger cooling towers, though they may be obtained on special order.

Condenser

Washer-Oiler

Air Filter Washing, Oiling Machine

HPAC 37—The "Safe-N-Ezy" air filter washer-oiler has been developed by Paxton-Mitchell Co., 27th and Martha Sts., Omaha 5.

Operating on the principle of centrifugal action, the machine is used to spin filters which are placed in an interior basket. According to the manufacturer, filters are cleaned, rinsed, spun dried and oiled in one operation.

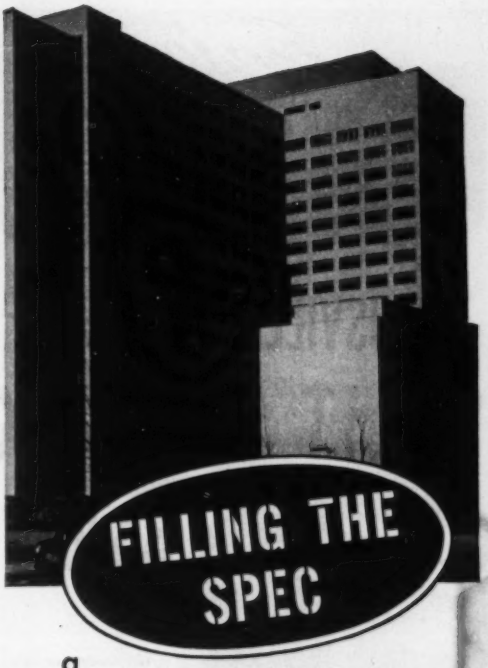
The unit is recommended for use in cleaning standard size, permanent type filters having wire mesh elements. Plans for distribution of the unit have not been completed. However, a franchise plan under which the machines would be leased to licensed operators is under consideration.

Packaged Boiler

HPAC 38—The "Ticosteam" generator, a packaged steam power plant, has been introduced by Titusville Iron Works Co., Titusville, Pa. The unit is completely assembled, finished, tested and certified at the factory. Operation is fully automatic, with all controls contained in a single push button controlled station. Mounted on a steel skid, the generator may be installed on level and solid floors without foundation construction. No stack is required. Available in a full range of sizes, the generators are designed for light oil and combination light oil and gas, and for straight gas operation. According to the manufacturer, it has a combustion efficiency of 80 percent plus and thermal efficiency of not less than 80 percent for oil firing and 75 percent for gas firing. With a minimum heating surface of 5 sq ft per boiler hp, the generator is quiet in operation. Applications include factories, hospitals, office buildings, etc.

Variable Output Fan Control

HPAC 39—Control of fan output from 15 to 100 percent of full load is provided by the new vane control of Westinghouse Electric Corp., Sturtevant Div., 200 Readville St., Hyde Park, Boston 36. The control changes the spin of entering air to modify fan pressure, and no change in speed of either fan or motor is necessary. This permits use of constant speed squirrel cage motors. Four models are available—one for use with light duty fans, another for handling of dusty gas, a third for industrial



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Fort Hamilton Hospital, Brooklyn, New York – one of the newest, most modern hospitals in our country today – where DEPENDABILITY governs the selection of all equipment – where FAIRBANKS valves are used in the plumbing, heating, air conditioning, fire line and sterilizing systems.

Dependability – a quality that does not permit compromise – a quality proven only by service rendered. Over fifty years of proven service, over fifty years of developing sound valve designs, pursuing progressive manufacturing methods and taking pride in a job well done have given to each and every Fairbanks valve the quality of dependability – Fairbanks Dependability.

Architects: Skidmore, Owings & Merrill, New York City
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General Contractors: Cauldwell-Wingate Company, New York City
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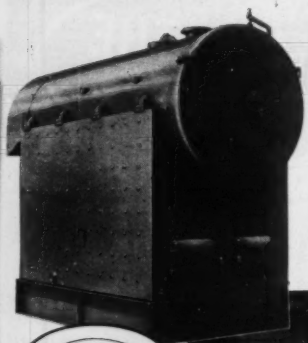
Enjoy
EASY BOILER REPLACEMENT
in tough entry conditions!

TITUSVILLE "Compact"
SPLIT FIREBOX
Boilers



Left: Assembled view of Titusville "Compact" Split Firebox Boiler.

Right: The Titusville "Compact" Split Firebox Boiler with sections opened, suggesting ease of manipulation.

For replacement installations where entrance conditions are not sufficient for the standard boiler, Titusville "Compact" Steel Boilers are obtainable in split firebox design. This practical expedient permits passage of the boiler in unit sections through narrow openings, with easy reassembly. Send us your replacement problem, and let us recommend the best solution for you! Request Bulletin Form C-7959 for Clearance Dimensions.

THE TITUSVILLE IRON WORKS COMPANY
A division of Struthers Wells
TITUSVILLE, PENNSYLVANIA

applications where gases are free from solids, and the last for industrial and ventilating service where shaft bearings are supported on the fan casing.

Control Station

HPAC 40—A new oiltight pendant push button control station, the "Bulletin 800T," is available from Allen-Bradley Co., Milwaukee, Wis. It is designed for use as a portable control, or for suspension above the machine, and it may be obtained in sizes consisting of from three to ten units. The standard stop unit is a wobble stick, but this also is available as a mushroom head mounted on the bottom or front of the enclosure. Special stations can be built with any combination of pilot lights, push button units, selector switch units, jogging units, or key-operated units.

WE HEAR THAT . . .

The first annual industrial contractors' clinic, sponsored by *OWENS-CORNING FIBERGLAS CORP.* at its research laboratories and plant in Newark, Ohio, was attended by 45 representatives of 35 industrial insulation contracting firms. The clinic is designed to acquaint men who sell and apply the company's products with its manufacturing processes, and with new methods and installation techniques.

FARR CO. has removed office and production facilities to 2301 E. Rosecrans Ave., El Segundo, Calif. The mailing address is P.O. Box 10187, Airport Station, Los Angeles, 45. The company's Chicago branch office and warehouse have moved to larger quarters at 5423 W. Belmont Ave.

NATIONAL RADIATOR CO., Johnstown, Pa., recently passed its 57th birthday as a manufacturer of heating and industrial equipment. In 1894 the Fowler Radiator and Mfg. Co. was formed in Norristown, Pa., and at the end of the first year, had a roster of 33 employees. Today, there are company plants in New Castle, Middletown, Duncansville, and Danville, Pa. (in addition to the Johnstown plant), and in Trenton, N. J.

The new plant of *WESTINGHOUSE ELECTRIC CORP.* which is now under construction in Union City, Ind., will be geared to produce 75,000 electric motors (of from 1/20 to ½ hp) per month, and will bring approximately $1,500,000 a year into the community in wages and salaries.

TEMPERATURE EQUIPMENT CORP., Chicago, has formed a new department for the distribution of industrial heating equipment, including the steam generators made by *CYCLOTHERM DIV., U. S. RADIATOR CO.*, Detroit, and the direct fired unit heaters made by *AMERICAN FOUNDRY & FURNACE CO.*, Bloomington, Ill. *JOSEPH DAVID*, formerly national sales manager, Dutton Co., Kalamazoo, Mich., will be in charge of the new department.

RAY MILLER, INC., New Jersey, specialist in resistant materials for special piping problems, has opened a new branch at 4234 Kanawha Turnpike, South Charleston,

W. Va. The company handles chemical, heat and corrosion resistant pipe, valves, fittings, and tubing of various alloy materials, including stainless and others—aluminum, nickel, lead, stoneware, glass, hard rubber, various types of plastics, etc.

McDONNELL & MILLER, INC., Chicago, recently conducted a five day training school for 14 men from its representing offices in various cities in the U. S. and Canada. The men were given training in the construction, installation and application of the company's safety devices for steam and hot water boilers, and company policies and customer relationships were explained. Principal speaker was *JOHN JAMES*, in charge of research for the corporation.

Construction of a 24,000 sq ft addition to the present engineering building began recently at the Glendale, Calif., plant of *GENERAL CONTROLS CO.* The new structure will be two stories high, and will be devoted entirely to research and engineering activity.....*WOLVERINE TUBE DIV., CALUMET AND HECLA CONSOLIDATED COPPER CO.*, now has exclusive rights to produce tubes by the patented forming and brazing process of *KARMAZIN PRODUCTS CORP.*, Wyandotte, Mich. The division will now be able to manufacture brazed tubes of both ferrous and non-ferrous metals.

The Chicago midwest sales headquarters for *SARCO CO., INC.*, recently was moved to new and larger space at 322 W. Randolph St., Chicago 6.....*ILLINOIS ENGINEERING CO.*, Chicago, has appointed *PEERLESS BROS. AGENCIES LTD.*, 3671 Main St., Vancouver, B.C., and *TENNESSEE HEATING SALES CO.*, 1311 Broadway, N.E., Knoxville, Tenn., as its representatives in these areas.

The first national sales conference of the new *PLATECOIL DIV., KOLD-HOLD MFG. CO.*, Lansing, Mich., was held recently at Lansing. Attending were 35 sales representatives from 18 sales offices located in principal cities east of the Rocky Mountains. Prof. *C. H. PESTERFIELD*, Michigan State College, spoke on heat transfer fundamentals and calculations and *E. W. HOPPER*, chief chemical engineer of Crucible Steel Co., talked on stainless steel as applied to "Platecoils."

ACME INDUSTRIES, INC., Jackson, Mich., has appointed *BUSCH-HODGES CO.* as the Pittsburgh representative, to handle its complete line of refrigeration and air conditioning products. . . . . .*UNITED STATES AIR CONDITIONING CORP.*, Minneapolis, has appointed *AIRKO AIR CONDITIONING CO.*, Miami Beach, as its exclusive representative in Dade County, Fla.

BALDWIN-HILL CO., Trenton, N. J., has been authorized to use a certification label on its No. 1 cement and blanket insulating products. The nationwide certification program, sponsored by the *INDUSTRIAL MINERAL WOOL INSTITUTE*, is based on standards and requirements published by the U. S. Dept. of Commerce, and products certified conform to Commercial Standards CS117-49 and CS105-48 as issued by the National Bureau of Standards.

This year five boys and five girls were named recipients of ten $500 *ALLIS-CHALMERS MFG. CO.* college scholar-

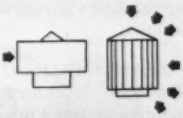
do you know

the TRUTH about ventilators?

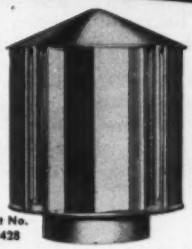
Ventilators are usually selected on the basis of their *capacity ratings*. That makes sense, but do you know that:

1. Capacity ratings of most ventilators are *not* certified.

2. Capacity ratings of most ventilators are based on *horizontal* wind tests only.



Breidert Air-X-Hausters
provide safe, sure ventilation no matter which way the wind blows!

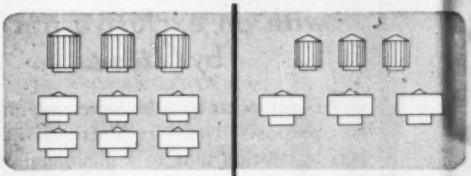


Patent No. 2269428

and . . . Breidert Air-X-Hausters are the *only* ventilators with published certified capacity ratings based on tests* made with wind blowing in *all* directions as shown above.

Only such tests can guarantee the capacities a ventilator will deliver under actual operating conditions. No matter which way the wind blows, barring interior negative pressures, the Breidert provides safe, sure ventilation . . . on roofs, vent flues, chimney tops. Stationary, no moving parts, nothing to jam or get out of order.

HOW YOU CAN GET BETTER RESULTS WITH LESS MONEY



It takes fewer Breiderts to do the job as same size conventional ventilators. (or) *You can use the same number of smaller size Breiderts to do the same job as conventional ventilators.*

Get *all* the facts! Write today for complete Engineering Data Book, including certified capacity ratings. Address Dep't A.

**By Pittsburgh Testing Laboratories*

THE G. C. BREIDERT CO.

3129 San Fernando Road, Los Angeles 65, Calif.

Representatives in principal cities throughout the U.S.

ships, awarded to high school seniors who are the children of any of the company's employees. Scholarships may be renewed each year if the students satisfy certain requirements set by the scholarship committee, and the money may be applied to tuition, books, room and board, or other expenses.

CLEAVER-BROOKS CO., Milwaukee, has appointed *KEATTS THERMAL EQUIPMENT CO.*, 3851 N. High St., P. O. Box 3138, Station B, Columbus, Ohio, as representative for the sale of its boiler equipment. The new representative will handle a territory comprising 36 Ohio counties.

SPANG-CHALFANT DIV., NATIONAL SUPPLY CO., Pittsburgh, has moved its New York City offices to a new building at 600 Fifth Ave., corner 48th St. Also being moved are *NATIONAL SUPPLY EXPORT CORP.*, and the export department of the company's *ENGINE DIV.*

HAJOCA CORP., Philadelphia, recently opened three new display rooms at its Richmond, Va., Danville, Va., and High Point, N. C., branches. . . . . *THE AUSTIN CO.*, engineers and builders, has moved its eastern district offices to the new 600 Fifth Ave. Building, New York City.

THE GEORGE F. BERTRAND CO., Philadelphia, has been appointed representative in the eastern half of Pennsylvania, and part of Delaware and New Jersey by *TRION, INC.* The new representative will sell and service the company's electrostatic air filters.

To help engineers meet problems of human relations often encountered in their work, particularly in foreign countries, *HARRY A. KULJIAN*, Philadelphia engineer, has established two scholarships for seniors at the *MASSACHUSETTS INSTITUTE OF TECHNOLOGY*. The scholarships will help finance studies in world affairs, economics and the humanities.

ZINTEL, BYFIELD & CO., INC., 1217 W. Washington Blvd., Chicago 7, has been appointed factory representative to handle activated carbon, air purification equipment, for *PUR AIR DIV., AMERICAN SOLVENT RECOVERY CORP.*, Columbus, Ohio.

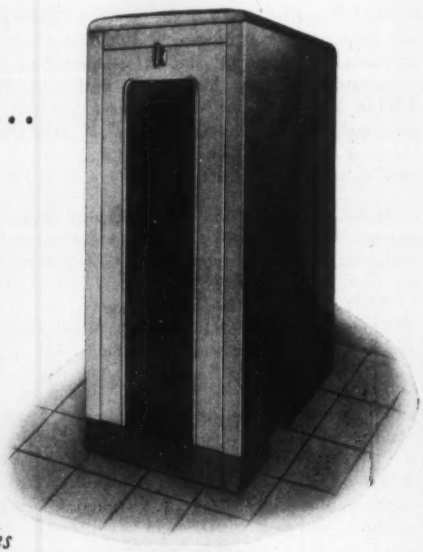
A new all purpose thermometer, model 8689, featuring a stainless steel case, is now being manufactured by *TAGLIABUE INSTRUMENTS DIV., WESTON ELECTRICAL INSTRUMENT CORP.*, Newark, N. J. . . . . *INTERSTATE SALES CO.*, 123 E. 18th St., New York 3, is offering a new model mechanic's protractor for measuring angles up to 180 deg. Three readings can be obtained at one setting: readings for outside angles; for inside angles; and for in. per ft against degrees, up to 24 in. per ft (63 deg-26 in.).

BRONZE BEARINGS, INC., Cranford, N. J., is now manufacturing an enlarged, improved line of its bronze bearings and bushings. These bearings range up to as large as 24 in. in diameter, and are available in a variety of types—plain, flanged, split, or any combination.

Beauty and Strength for Your Boiler...

...with an exclusive design by Atlas

A boiler jacket by Atlas serves two important purposes. First—its functional design cuts installation time to a minimum. Saves labor costs—*increases profits*. Secondly—its beauty of design lightens your sales load—finds new prospects—enlarges your market. Moreover—an Atlas jacket is yours alone . . . built to *your* specifications, designed to best fit *your* market demands.



Send Your Boiler Specifications to Us for Cost Estimates

Atlas MANUFACTURING CO.
EUSTIS AT ROBBINS ST. ST. PAUL 4, MINN.

ALSO MANUFACTURERS OF
FURNACE CASINGS and BLOWER HOUSINGS

WHO'S WHAT

J. PHILLIPS COSGROVE has been elected executive vice president of *AMERICAN RADIATOR & STANDARD SANITARY CORP.*, Pittsburgh. As vice president of European divisions, his former post, he was in charge of the corporation's foreign operations. All other officers of the corporation have been re-elected, three promoted and four others named. *JOSEPH A. GRAZIER*, secretary, *JOHN E. KING*, treasurer, and *WALTER WHITTAKER*, comptroller, were elected vice presidents. The new officers are *THOMAS W. McNEILL*, vice president, purchasing; *JOHN C. REED*, vice president, research; *HOWARD L. SPINDLER*, vice president, public relations; and *ALBERT W. SWAN*, assistant treasurer.

DAVID E. FEINBERG has been appointed a vice president of *UNITED STATES AIR CONDITIONING CORP.*, Minneapolis, Minn. Since 1949 he has been manager of the company's refrigeration division.....*C. C. GROTE*, formerly eastern sales manager, is now sales manager (responsible for the entire sales) of *SPORLAN VALVE CO.*, St. Louis. Assisting him is *J. T. BARRY*, most recently sales engineer in the midwest, who has been promoted to western sales manager, with headquarters in St. Louis. *FRANK JAEGER*, formerly associated with Servel, Inc., has been appointed sales engineer for the midwest territory.

Recently elected members of the board of directors, *YORK CORP.*, York, Pa., are *JOHN R. HERTZLER*, vice president and general sales manager; *J. KEITH LOUDEN*, vice president and assistant to the president; *E. P. VANDERWICKEN*, vice president and treasurer, and *RICHARD T. NALLE*, president, Midvale Co., Nicetown, Pa. The first three men fill vacancies caused by the death of *WALTER GEIST*, former president, Allis-Chalmers, and by the resignations of *JOHN S. McMARTIN* and *LLEWELLYN WILLIAMS*, veteran board members. Mr. Nalle succeeds the late *WILLIAM S. SHIPLEY*, who was chairman of the board.

THEODORE E. BRIDGE, who has written a number of articles published in *HEATING, PIPING & AIR CONDITIONING*, including a series on how to space pipe supports and on designing piping for flexibility, is now a mechanical engineer with *UNITED ENGINEERS & CONSTRUCTORS, INC.*, Philadelphia.

GEORGE C. RODGERS has been named manager of the military sales dept.. *HERMAN NELSON DIV.*, (Moline, Ill.) of *AMERICAN AIR FILTER CO.*, Louisville, Ky. Mr. Rodgers previously was consultant to Berry Motors, Inc., Corinth, Miss. *IRVING W. CLARK* is the new manager of the company's military and special contracts dept. at Louisville. Previous to joining the company, he was executive vice president for General Plywood Corp., Louisville.

AMERICAN STANDARDS ASS'N., New York, recently awarded certificates of service to members of its standards council in recognition of their work in the development of American Standards. Among those honored were *C. E.*

It's a cinch to ream pipe with this

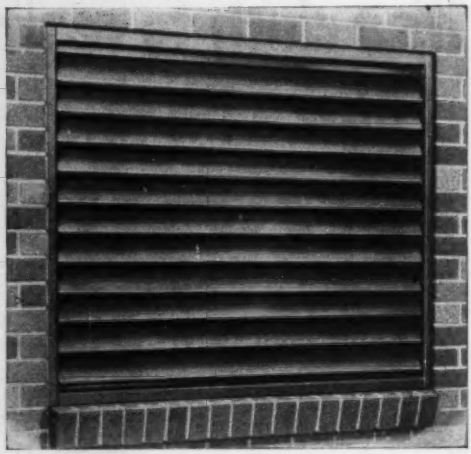
RIDGID

● RIDGID LonGrip reamers have that extra-long-taper that cleans the burr smoothly out of pipe or conduit almost without effort. Just a few light ratcheted strokes do the job. Furnished complete with ratchet handle. No. 2 Reamer unit sold separately for use in RIDGID 00R small ratchet die handle. Two sizes, No. 2, ⅛" to 2" pipe; No. 3, ⅜" to 3" pipe. These RIDGID new type pipe reamers really do save your time, work — and pipe. Ask for them at your Supply House.

Buy reamer complete or reamer unit separately for use with 00R die handle.

RIDGID

Work-Saver Pipe Tools



Now you can equip any wall opening with Swartwout

Airlouvers

The conveniently wide size variation available in Airlouvers virtually gives you custom-made equipment at economical standard costs. It's easy to fill any size wall opening with one or more Airlouver units—in either adjustable or fixed types.

These louvers have excellent appearance and high utility. The percentage of free opening area is as large as possible consistent with complete weather-proofness. Strong formed channel frame construction houses overlapping blades. Several methods of operating are optional. Various types of mounting facilities enable you to make the most suitable installation according to building construction. Write for Bulletin 339F.

Swartwout makes a complete line of gravity and powered roof ventilators to fill every need on any type of industrial, commercial or public building.

The Swartwout Co.

18511 Euclid Avenue • Cleveland 12, Ohio

Industrial Ventilation Specialists Since 1904

WILSON, vice president, *WORTHINGTON PUMP AND MACHINERY CORP.*, Harrison, N. J., representing the *AIR CONDITIONING AND REFRIGERATING MACHINERY ASS'N.*; and *W. VERNON BRUMBAUGH*, executive secretary, *REFRIGERATION EQUIPMENT MANUFACTURERS ASS'N*, Washington, D. C.

Recent appointments at *BUSH MFG. CO.*, West Hartford, Conn., include *WILLIAM DONOVAN*, vice president, *HEAT-X-CHANGER CO.*, New York, now director of engineering for that company and for Bush; and *JAMES A. MULCAHEY*, formerly sales engineer for Cecil Boling Co., New York, now sales manager of Bush.

JOHN M. FRANK, president of *ILG ELECTRIC VENTILATING CO.*, Chicago, recently was elected president, for the ensuing year, of *THE NATIONAL ASSOCIATION OF FAN MANUFACTURERS.*

Four new members have been elected to the junior board of directors, *DRAVO CORP.*, Pittsburgh. They are *A. J. BROSIUS*, assistant to the vice president, Union Barge Line Corp.; *K. C. COX*, engineer, the contracting div.; *F. J. LLOYD, JR.*, operations manager, Keystone div., and *B. B. REILLY*, manager, air conditioning and combustion dept.

Two new division appointments have been made at *ALLIS-CHALMERS*, Milwaukee, Wis. *J. F. ROBERTS*, since 1942 manager of the hydraulic dept., is now director of engineering. Previously he had been head hydraulic engineer for the Tennessee Valley Authority at Knoxville. *R. C. ALLEN*, formerly manager and chief engineer of the turbo-power development dept., is now consulting engineer. The company has formed a new mechanical power department, headed by *W. A. YOST*, who has been manager of the steam turbine dept. since 1947.

ROBERT L. GIBBS is now manager of sales personnel of *MUELLER BRASS CO.*, Port Huron, Mich. Mr. Gibbs, who has been with the company for the last ten years, was formerly head of the sales promotion and advertising div. He is succeeded in that post by *E. A. FAIRCHILD*, formerly account executive with the Price, Hedrick & Tanner advertising agency of Saginaw, Mich.

A. F. DAVIS, a director, vice president and secretary of *LINCOLN ELECTRIC CO.*, Cleveland, and secretary, *THE JAMES F. LINCOLN ARC WELDING FOUNDATION*, recently was awarded an honorary Doctor of Science degree at *MT. UNION COLLEGE*, Alliance, Ohio. *J. S. ROSCOE*, with the company since 1924 (most recently as district manager in the Chicago area), has been appointed director of purchasing.

The new assistant manager, application engineering dept., *WESTINGHOUSE ELECTRIC CORP., MOTOR AND CONTROL DIV.*, Buffalo, N. Y., is *T. C. FINNELL*, who formerly was manager of the metallic rectifier section. He succeeds *T. R. LAWSON*, who has been transferred to the company's headquarters in Pittsburgh.

JOHN W. MAYER, formei service engineer for *C. A. DUNHAM CO.*, Chicago, has joined the purchasing dept.

to handle procurement of machinery and materials relative to defense contracts. *LARRY T. HAYES* has been promoted from within the department to the post of assistant purchasing agent. *EDWARD MAYOR*, formerly of Owens-Illinois Glass Co., has joined the company as assistant purchasing agent to replace *ROBERT J. WIRTH*, who recently returned to duty with the U. S. Navy.

ERWIN S. MASON, JR., has been appointed sales engineer in the Cincinnati, Ohio, territory for *MACHINERY DIV., DRAVO CORP.*, Pittsburgh. Mr. Mason was formerly vice president and secretary of Mason and Lowman Co., Cincinnati.

J. BROOKS HINE, formerly with the Jack and Heintz Co. and the Brush Development Foundation, Cleveland, heads the newly organized research div., engineering dept., *VIKING AIR CONDITIONING CORP.*, Cleveland. Previously he had served as physicist and research engineer with the Manhattan Project in Oak Ridge, Tenn., and in California. *LEO KUHN* will represent the company in a territory covering parts of Indiana, Ohio, Kentucky and West Virginia. He replaces *JOHN GREEN*, who has been transferred to the eastern territory. *RICHARD F. GANG* has been promoted to the newly created post of assistant sales manager. Formerly, he was sales promotion manager of the heating dept.

HARRY A. KIESELBACH, who was general manager, insulation dept., *JOHNS-MANVILLE SALES CORP.*, until his recent retirement, has been retained as technical consultant to *THE MAGNESIA INSULATION MANUFACTURERS ASS'N*, Washington, D. C. He has served as chairman of the association's technical committee since it was formed in 1945.

RUSSELL J. CAMERON, formerly vice president in charge of sales, has been elected president of *ROSS OPERATING VALVE CO.*, Detroit, Mich. He succeeds *JOHN SAINSBURY*, who will remain as an active consultant and member of the board of directors. *W. E. HENNELLS* has been named vice president, and *L. M. BLOMGREN*, secretary and treasurer. Members of the board were re-elected.

FRANK A. DAVENPORT has been assigned as sales engineer in Atlanta, Ga., for *OWENS-ILLINOIS GLASS CO., KAYLO DIV.*, Toledo, Ohio. The territory includes the states of North and South Carolina, eastern Tennessee, Georgia, Alabama, and Florida. Before joining the company in 1950, Mr. Davenport ran his own building supply business. He replaces *C. H. RAMIEN*, who is now acting as resident engineer at a company installation in Port Arthur, Tex.

CLINTON MILLMAN has been appointed to the newly created post of manager of operations for *BAKER REFRIGERATION CORP.*, South Windham, Maine. For the last three months he has been associated with the company in a consulting capacity. Previously, he had been with Ranney refrigerator Co., Greenville, Mich., and during the past year, has operated his own management and engineering consulting business.

WEBSTER
KINETIC* BURNER

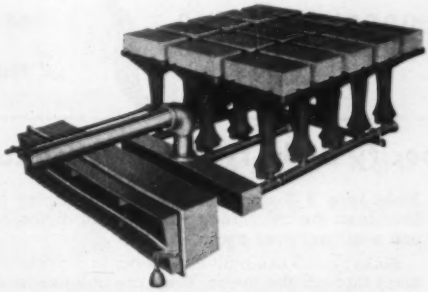
For Low Pressure Gas

The Webster Kinetic consists of a multiplicity of full venturi mixers with flame retention nozzles. These are assembled in a metal casing complete with pilot and louvre. It may be used with natural, mixed or liquefied petroleum gases. Standby oil burners may be used when desired. As a multiple head assembly it is available in 25 standard sizes of from 4 heads to 48 heads, and can be supplied in any size or shape. Natural gas input ratings from 560,000 Btu/hr to 6,720,000 Btu/hr at 4" wc.

For complete information request Series B8 Bulletins.

●

WEBSTER
SERIES F 600 BURNER
For Low Pressure Gas



Designed for LOW GAS PRESSURE
INTERCHANGEABLE PORTS
RADIANT fire brick top
NO COMBUSTION CHAMBER required
Will NOT VIBRATE
LOW draft loss
ANY SHAPE and SIZE
INTEGRALLY MOUNTED pilots

*TRADEMARK

The WEBSTER ENGINEERING COMPANY
TULSA, OKLAHOMA
Division of SURFACE COMBUSTION CORPORATION, Toledo, Ohio

THEODORE R. PEYREK, head of the *HEATING AND VENTILATING DIV., L. J. WING MFG. CO.*, Linden, N. J., was granted the honorary degree of mechanical engineer by *STEVENS INSTITUTE OF TECHNOLOGY*, Hoboken, N. J., at recent commencement exercises.

DR. LeVAN GRIFFIS, chairman of applied mechanics, has been named manager of a new engineering mechanics division, *ARMOUR RESEARCH FOUNDATION, ILLINOIS INSTITUTE OF TECHNOLOGY*, Chicago. He will head three new departments: structural research, mechanism and propulsion research, and heat-power research.

JOHN R. HEMING is now project engineer in charge of combustion control for *THE HAYS CORP.*, Michigan City, Ind. He will be in charge of obtaining all engineering data needed to complete control orders, and will handle the entering of these orders. He joined the company in 1936.

ALBERT DE LA HABA, for 17 years chief engineer for the West Indies Sugar Corp. and for five years engineer in charge of the Fifth Naval Base, Norfolk, Va., has been appointed chief engineer for *CONSULTANTS AND DESIGNERS, INC.*, New York consulting engineers.

THE LAMSON CORP., Syracuse, N. Y. has appointed *FRED WOHLFARTH* as its new installation manager, in charge of installing the company's products throughout the United States. Most recently, he has been with Ford Bacon & Davis, New York.....*A. P. JEFFERY* is the new power plant equipment sales engineer in the Albany and Schenectady, N. Y., territory for *THE SWARTWOUT CO.*, Cleveland.

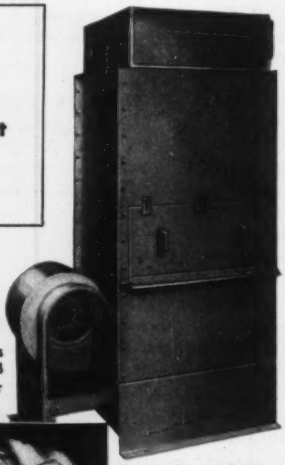
WILLIAM J. THOMAS, general sales manager, *BABCOCK & WILCOX TUBE CO.*, Beaver Falls, Pa., has been named to the *TUBING INDUSTRY ADVISORY COMMITTEE* which functions under the Office of Price Stabilization. He also has been named to the *WELDED AND SEAMLESS STEEL TUBING INDUSTRY ADVISORY COMMITTEE* which functions under the Iron and Steel Div., National Production Authority.

The new advertising and sales promotion manager (publicity manager) of *L. J. WING MFG. CO.*, Linden, N. J., is *FRANK STORY*, who most recently was with the publication, Metal Working.....*RICHARD J. BAKEWELL*, formerly Pittsburgh representative of the National Foundry Association, has been named sales representative for the Philadelphia district of *NATIONAL SUPPLY CO., SPANG-CHALFANT DIV.*

The newly appointed Pacific Coast district manager of *MANNING, MAXWELL & MOORE, INC.*, is *EDWIN H. PRICE*, who joined the company in 1930. He succeeds *NEWTON P. SELOVER*, who is now director of export planning.....*ECLIPSE FUEL ENGINEERING CO.*, Rockford, Ill., has appointed *CHARLES W. GUPTIL* as its representative, replacing *HENRY E. BALSLEY* who has retired. Mr. Guptil has been associated with Mr. Balsley in the St. Paul, Minn. office since 1949.

If your COOLING TOWER SPECIFICATIONS read...

1 Must save water
2 Must be independent of natural air movement
3 Must be quiet



Specify Binks type B mechanical draft towers

Binks type B Towers use a proved spraying process to transfer heat from the circulating water to the atmosphere, permitting its use over and over again.

Binks type B use built-in blowers to provide *controlled* air movement through the tower. They are independent of natural breeze ...hence can be operated indoors or outdoors.

Binks type B towers operate *quietly* because the squirrel-cage blowers provide ample air movement while running at slow speeds.

Binks Type 2-B Tower

The non-clogging ROTO-JET nozzles in a Binks tower produce maximum cooling because their whirl chamber design causes fine fluid break-up.

Send for this literature for details: Bulletin 46—Type 2-B (3 to 90 GPM) Bulletin 47—Type 2-BB (96 to 180 GPM)

THERE'S A BINKS TOWER FOR EVERY COOLING JOB

Binks MANUFACTURING COMPANY

REPRESENTATIVES IN ALL PRINCIPAL CITIES ■ 3118-38 CARROLL AVENUE, CHICAGO, ILL.

NEW BOOKS & REPORTS

Handbook Gives Information About Oil Burning

Information about oil burners, combustion, atomization, vaporization, refining, heating, etc., is contained in the new Handbook of Oil Burning (978 pages) published by Oil-Heat Institute of America, Inc. There are 48 contributing authors and editors, each of whom is a recognized specialist in his field. Frank H. Faust, mgr. trade relations, air conditioning dept., General Electric Co. is editor-in-chief; G. T. Kaufman, technical secretary, Oil-Heat Institute, is editor. Copies are available from the institute, at 6 E. 39th St., New York 16, N.Y., at $10.00 a copy, or $16.00 for the morocco-bound edition, with owner's name imprinted. (This handbook will be reviewed fully in a forthcoming issue.)

New Standard Covers Nonflammable Medical Gas Systems

A new standard, No. 565, prepared, adopted and issued by the National Fire Protection Association, covers nonflammable medical gas systems, and supersedes the previously adopted standard covering piping systems "for the Distribution of Anesthetic Gases and Oxygen in Hospitals and Similar Occupancies." The previous standard permitted the piping of combustible anesthetic gases, but this practice is prohibited by the new standard. Standards in the latest publication apply to piped oxygen for therapeutic purposes, and to the piping of oxygen or nitrous oxide and other nonflammable gases to any area of a hospital for medical purposes. Although oxygen and nitrous oxide are nonflammable gases, they accelerate combustion and so leakage or rupture of any part of the piping system must be guarded against. Standards cover the central supply system, the pipe lines, the shutoff valves, station outlets, installation and testing of piping systems, and dispensing equipment.

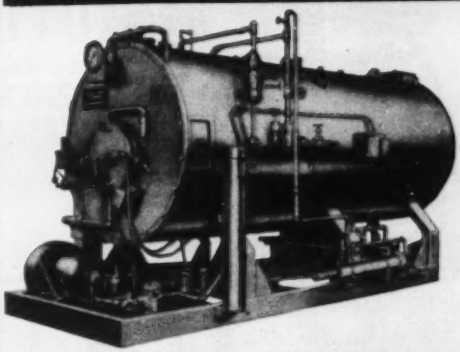
Copies may be obtained from NFPA Executive Office, 60 Batterymarch St., Boston 10, Mass., at 25 cents per copy.

ASME Semi-Annual Meeting Papers Cover Piping and Related Fields

Piping flexibility, stress conditions in flanged joints, disposal of inflammable vapors, force reactions in control valves, and a variety of related topics were covered in a number of the papers presented at the recent semi-annual meeting of the American Society of Mechanical Engineers.

Piping Flexibility Analysis by Model Test (paper no. 51-SA-24), by Lale C. Andrews, describes briefly the model-test flexibility analyses of piping systems which have been made during the past ten years (for nearly a hundred oil, power and chemical companies, and for two navies) under the author's direction. At present, the reactions, deflections and stress effects of the various forms of loading in an intricate piping system under thermal expansion are obtainable by mathematical calculation as well as by tests of scale models. The author stresses the particular advantage of the latter method, stating that the time required for a mathematical analysis increases divergently with the complexity of the problem, while that for a model test increases convergently since time required

MODERNIZE
with the
AMESTEAM
GENERATOR



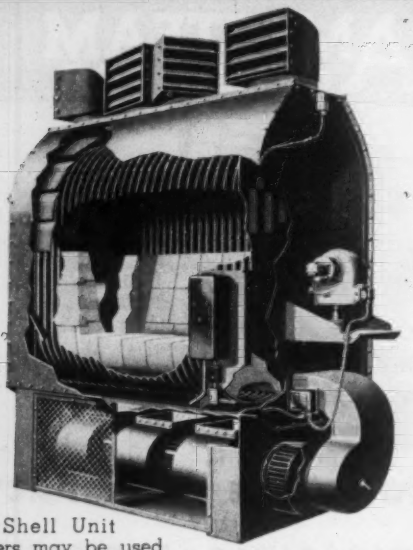
● COMPLETE ● COMPACT
● ACCESSIBLE ● EFFICIENT
● AUTOMATIC
10 to 500 h. p.—
15 to 200 lbs. capacities

Here are the facts!

WRITE FOR YOUR COPY

AMES IRON WORKS
BOX 2007 OSWEGO, N. Y.
Builders of Better Boilers since 1848
Manufactured under
License in Canada by VOLCANO, Ltd., Montreal, P. Q.

LEE SHELL UNIT HEATER



Lee Shell Unit Heaters may be used singly or as a central system with the heated air distributed through ducts.
The efficiency of Lee Counter-current flow reduces fuel consumption while the rugged simplicity of the system decreases cost of installation, assures low maintenance charges and provides ventilation without additional cost.

The LEE line . . .
Steel Encased Tubular Heater
Tubular Unit Heater
Brick-Set Tubular Heater
Shell Unit Heater
Write now for more information

LEE CORPORATION
1001 TATNALL STREET
WILMINGTON, DELAWARE

per point of restraint becomes less as such points increase in number.

Stress Conditions in Flanged Joints for Low Pressure Service (paper no. 51-SA-4), by E. O. Waters and Frank S. G. Williams, covers low hub and ring type welding flanges for low pressures such as water service. Thirteen test runs were made, in which stresses and bolt loadings were measured using electric resistance strain gages. Theoretical and test stresses were compared. The values, in general, agreed well, and agreement improved as water pressures increased. Important "primary" stresses remained within safe limits. Hubbed and ring flanges gave different stress distributions with lower peak values for hubbed flanges.

Some Aspects of the Design and Economic Problems Involved in the Safe Disposal of Inflammable Vapors from Safety Relief Valves (paper no. 51-SA-18), by S. Chesler and B. W. Jesser, presents three approaches now employed in the design of pressure relieving systems in an effort to reduce their costs without sacrificing safety.

The first method involves the use of diffusion equations in determining maximum concentration of a gas to be expected at grade when a given quantity of gas is discharged from a safety relief valve into the atmosphere (an open system). With a second method, applicable to closed systems (terminating in refinery flares or water quenched stacks), sizes of the discharge piping may be reduced by setting the pop pressure of the conventional safety relief valve below the design pressure of the vessel. The third method (also for closed systems) involves application of a special type of safety relief valve now being developed to reduce or eliminate the effects of back pressure and thus reduce line sizes in the discharge system. Experimental valve capacity data observed by the authors are included.

Dynamic Force Reactions in Double-Ported Control Valves (paper no. 51-SA-1), by C. F. King and G. F. Brockett, offers a solution to problems created by torsional force reactions on V-port inner valves, and vertical force reactions on plug-type inner valves in double-ported control valve bodies, which are of a sufficient magnitude to cause concern if pressure drop is high. These forces are proportional to the mass velocity of the flowing fluid. It is possible to design inner valves so that forces will be reduced to a point where they are not objectionable.

Methods of Reducing Dust Emission from a Spreader-Stoker Fired Boiler Furnace (paper no. 51-SA-20), by W. C. Holton and R. B. Engdahl, is based on 47 tests which were made on a continuous ash discharge, spreader stoker fired boiler. In addition to burning rate, variables investigated were amount of overfire air, use of air, steam, and steam-air jets, location of steam jets, degree of reinjection used, and coal size. These tests showed that the use of overfire jet turbulence decreased smoke density, carbon loss, and dust emission from the furnace. Steam jets located low in the rear wall gave lowest dust emission. Reinjection of all collected cinder decreased carbon loss to one fourth of its value without reinjection, but doubled the dust loading of the stack gases. Double screened coal was found to reduce dust emission appreciably.

These papers should be ordered, by number, from A.S.M.E. Order Dept., 29 W. 39th St., New York, N.Y. Prices are 25 cents for members, 50 cents for nonmembers.

For DEFENSE AGAINST CORROSION

... use

STEDCO FIN-TYPE RADIATION

... with Aluminum Fins

A NON-CORROSIVE HEATING ELEMENT

STEDCO fins are attached to the tubing in an inter-locking sleeve fashion and completely encase the center tubing. This makes a non-corrosive heating element plus giving a double contact surface area between fin and center tubing resulting in longer life and outstanding high heat capacity. One lineal foot of Stedco radiation with aluminum fins will give 1930 B.T.U. or 8 sq. ft. of E.D.R. per hour. Stedco radiation is also manufactured with steel fins.

Manufacturers of STEDCO *Compact Convectors*

Immediate delivery on Aluminum Fin Radiation

HIGH HEATING CAPACITY

For Industrial, Commercial and Institutional installations where top performance is demanded!

A STEDCO INSTALLATION

U. S. Veteran's Hospital
Wilkes-Barre, Pa.

Stedco radiation was the choice for this hospital where economical, dependable heating is a prime requisite. Stedco met and passed the rigid specifications and requirements.

It's the *LOW DOWN* DIRT trapped by WILSON'S HAIR FILTERS that GUARANTEES LONGER LIFE

In Wilson *Hair* Filters the entire dust-holding capacity is completely utilized. This means, *no surface dust stopping only*, but Full-Depth Dust Trapping at its best . . . and many extra months of filter life.

The *reasons* are so simple:

1. The hair media in Wilson *Hair* Filters act in the same manner as Mother Nature's proven way of filtering the air you breathe. It's the *hair* that cleans the air . . . more easily, more effectively, more economically.
2. The multi-directional distribution of the hair in Wilson *Hair* Filters literally invites all dust and dirt to come in and be trapped throughout the entire filter interior.
3. Most brands of air filters require oiling on their inlet surfaces. This stops dust prematurely, loads up the incoming air side and materially shortens filter life.

Wilson Hair Filters are not oiled on the inlet side. Instead, they receive an even distribution of mineral oil *on their outlet surface*, which:

(a) augments the already amazing ability of the hair itself, to catch and hold dust, and—

(b) builds an impregnable barrier which halts dust and dirt after reaching the furthermost practicable penetration point.

WILSON & CO., INC.
(Air Filter Division) 4100 South Ashland Ave., Chicago 9, Ill.

Wilson Hair Filters are another quality product of Wilson & Co., world-famous for meat products, sports equipment, pharmaceuticals, hair products, etc.

The famous Edgeseal, the original *Hair* Filter with the patented self-sealing edge.

The popular Honeycomb, the dressed up *Hair* Filter that is so easy to handle.

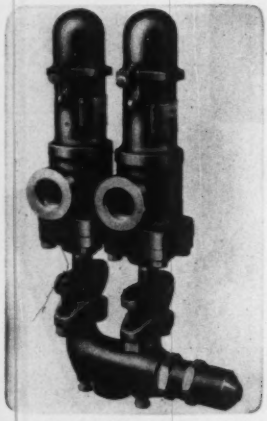
Save delay. Save dollars. Save doubt. Send for FREE sample with details and prices.

Patent Pending

Now!

A New Safety Valve, Built on a Better Principle

This improved equipment has the seat and moving parts of stainless steel; no danger of rusting fast! The parts are self-aligning and accurately made. The opening is full, giving the valve much greater capacity than earlier types.



Dual-outlet Valve Permits Re-seating and Testing Safety Valves While Refrigerating Plant is Operating

The new valve can be re-seated after it opens. It meets the requirements of the latest A.S.M.E. and A.S.A. B-9 Codes. Built in ½", ¾", 1" and 1¼" sizes.

Sensitive, dependable, and safe, this valve will give your refrigerating system the adequate protection you need.

Order today from your nearest Frick Branch or Distributor, or direct from

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA. U.S.A.

Also Builders of Power Farming and Sawmill Machinery

Two ISA Tentative Recommended Practices Cover Flowmeter Installations and Control Valves

Two new recommended practice publications have been prepared and sponsored by the Instrument Society of America.

Flowmeter Installations, Seal and Condensate Chambers, ISA RP3.1—According to the ISA, head-type fluid meter installations would be simplified greatly by the adoption of uniform practices in the fabrication of their seal and condensate chambers. This uniformity pertains to the overall dimensions, general arrangement and location of connections, and the minimum sealing volume required by conventional meters. If these recommendations were adopted, all similar types of seal and condensate chambers would be interchangeable with respect to installation dimensions, regardless of their source of supply.

Three methods of fabrication are shown in the drawings, each illustrating acceptable manufacturing practices. Two alternate types of condensate or seal chambers are illustrated, each of which may be fitted with any of the three end arrangements. The form of seal and condensate chamber advocated is consistent with those currently used in most installations.

Uniform Face to Face Dimensions for Flanged Control Valve Bodies, ISA RP4.1—The face-to-face body dimensions for flanged end valves of both cast iron and steel through 600 lb flange ratings are covered. Sizes included are ½ in. through 8 in. Only flanged valves which are in the category of diaphragm actuated control valves of the plug type are included.

The dimensions were developed by the majority of control valve manufacturers with the assistance of the National Steam Specialty Club. Adoption of these dimensions would allow piping design, where control valves are involved, without giving special consideration to the make of equipment used.

Copies of these booklets are available from the society, at the national office, 921 Ridge Ave., Pittsburgh 12, Pa. The price of RP3.1 is 50 cents, of the other booklet, 25 cents.

Standard on Steel Butt Welding Fittings

This revised standard, Steel Butt Welding Fittings, B16.9—1951, provides overall dimensions, tolerances and markings for wrought and cast carbon and alloy steel welding fittings in sizes of 1 to 24 in. Dimensions, presented in seven tables, are for long radius elbows, 180 deg returns, straight tees, reducing outlet tees, lap-joint stub ends, caps and reducers. Supplementary tables contain dimensions of welded and seamless steel pipe listed by schedule numbers and by strong wall, extra strong wall, and double extra strong wall.

Copies are available from The American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y., at 75 cents a copy.

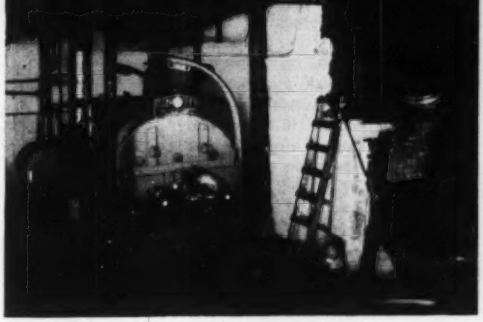
Recirculating Apparatus for Testing Hygrometers

This paper (research paper no. 2145), by Arnold Wexler, was reprinted from the Journal of Research of the National Bureau of Standards. It covers an apparatus that was developed for producing atmospheres of known

Dutton EconoTHERM

"PACKAGED" STEAM GENERATOR
WITH EXCLUSIVE OFF-CENTER FIRING

SHOWS BIG SAVINGS!



HERE'S WHAT OFFICIALS SAY AT W. B. PLACE & COMPANY, HARTFORD, WIS., CUSTOM DEERSKIN TANNERS:

"We are very much pleased with the Dutton gas-fired boiler . . . it has done an excellent job of heating, and been practically trouble free." As to cost of operation, *"our bills to date indicate a substantial saving . . . a big saving in labor."*

From the installation picture, you might compare the *appearance* of these boilers — but where *efficiency* begins, comparison ends! The compact Dutton EconoTHERM produces *160 h.p.*, against *90 h.p.* for the space-consuming old boiler beside it. From a cold start, the Dutton will produce 125 lbs. of steam pressure in just 15 minutes. The old unit took 2½ hours!

In Hartford — or wherever they're installed — "packaged" EconoTHERMS win praise for fuel efficiency, safety and durability. Delivering *twice* the power you'd expect in *half* the usual space, the EconoTHERM is self-contained, with fully automatic controls.

Exclusive Dutton "off-center firing" with rotary combustion gives you faster boiler water circulation, plus greater safety. Other features include: Large steam storage space . . . five or more square feet of water heating surface per rated h.p. . . . mechanical draft with short stack (no costly chimney) and choice of gas or oil firing.

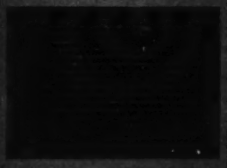
Learn about *all* the quality features of the Dutton EconoTHERM . . . WRITE NOW FOR BULLETIN EC-100G

Other types and sizes — 5 to 250 h.p.

Dutton BOILER DIVISION
HAPMAN-DUTTON COMPANY
KALAMAZOO • MICHIGAN
Boiler Makers Since 1880

McCORD
HEATING AND AIR CONDITIONING PRODUCTS

BLAST HEATING COILS—AIR CONDITIONING COILS—ALL TYPES



All copper spiral fin tube construction with the tubes formed or bent permits uniform expansion without strain. Headers are heavy wall construction with tubes brazed into extended ferrules formed in the headers. Fins are helically wound and mechanically bonded. May we send catalog?

VERTICAL TYPE UNIT HEATERS

A proven heating unit, modern in design, incorporating every unit heater advancement. McCord copper spiral fin tube construction creates air turbulence without undue restriction. Improved fan blades deliver large volume of air with minimum air noise. Guaranteed for 150 lbs. saturated steam pressure. Specify McCord.

HORIZONTAL TYPE UNIT HEATERS

A time proven heating unit, modern streamlined in design, quiet, yet its rugged construction adapts it to all types of installations, guaranteed for use on No. 150 p. s. i. steam pressure. All copper heating element, individual spiral fin tubes free to expand without strain on joints. Standard motors with standard bases used. Wide range of capacities.

Save fuel with McCord Unit Heaters.

McCord CORPORATION
DETROIT 11, MICH.

Build STAMINA into your pipe-lines

Reduce maintenance with D-F S-E* *Joints*

Shortages of manpower require you to build stamina in your lines. **Directed-Flexing Self-Equalizing*, an exclusive feature of Badger Expansion joints, assures all-curve flexing in the corrugated member. Thus, localized flexing stresses cannot form . . . metal fatigue cut to a minimum . . . breakdowns are virtually eliminated.

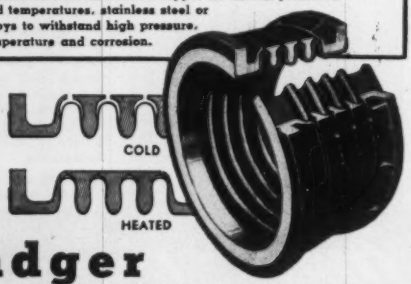
But that's not the whole Badger story. In addition to controlling the flexing movement *within* each corrugation, the specially designed Self-Equalizing Rings also control intra-corrugation movement. For unbeatable stamina be sure you get the exclusive Badger combination — Directed-Flexing Self-Equalizing — when you buy . . . specify Badger Expansion joints for every job.

Only Badger Expansion Joints have Directed-Flexing Self-Equalizing rings which progressively control the movement of the all-curve corrugations.

Plus 5 other big features

- **Packless . . . pressure-tight single tube — requires no maintenance**
- **Compact . . . approximately the size of flanged fitting**
- **Special forming . . . no structure weakening stresses**
- **Controlled heat treating . . . assures long life**
- **Wide range of traverse — pressure — temperature**

Fabricated from deoxidized copper for normal pressures and temperatures, stainless steel or alloys to withstand high pressure, temperature and corrosion.



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relative humidity, designed for research on and calibration of radiosonde hygrometer elements at temperatures above freezing, but equally useful down to −40 C. Design details and performance characteristics are given. Copies may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at 10 cents per copy.

ECPD Guidance Manual to Aid Prospective Engineers

A guidance manual intended for engineers who are aiding young men interested in the engineering profession recently was published by the Engineers' Council for Professional Development. The 15 page pamphlet, prepared by the ECPD guidance committee, urges members of local engineering societies and chapters of national societies to establish guidance committees to aid high school pupils in determining whether or not they are qualified for careers in engineering. The pamphlet explains briefly how to organize such committees, and lists aids especially useful in counseling high school boys.

The manual is supplemented by an appendix, "Shall I Study Engineering?" which is a questionnaire to be filled out by the student for the use of his advisor. Copies of the manual with questionnaire may be obtained from the council at 29 W. 39th St., New York 18. Price of the combination is 20 cents, of the manual separately, 15 cents of the questionnaire, 10 cents.

Other Books & Reports Received

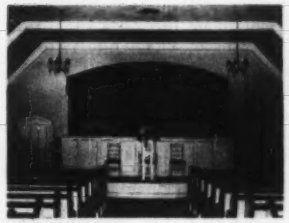
SIMPLIFIED PRACTICE RECOMMENDATIONS R243-51, UNORIFICED RADIATOR SUPPLY VALVES, AND R244-51, LOW PRESSURE THERMOSTATIC RADIATOR TRAPS AND FLOAT-AND-THERMOSTATIC TRAPS—These two listings, made available by the Commodity Standards Div., Office of Industry and Commerce, U. S. Dept. of Commerce, were proposed by the Steam Heating Equipment Manufacturers Association. Recommendation R243-51 lists the sizes, patterns and capacities of unorificed radiator supply valves (for use in two pipe, low pressure steam heating systems) that currently are in use and demand, and are regarded as affording an adequate selection for ordinary use and for stock. R244-51 is a similar listing of the sizes, patterns and capacities of thermostatic traps and float-and-thermostatic traps for use with steam heating systems. General provisions are included in both publications.

Printed copies of each listing may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at five cents per copy.

CLIMATE AND ARCHITECTURE, SELECTED REFERENCES—This new bibliography issued by the Housing and Home Finance Agency has been prepared to facilitate research in climatology as it relates to architecture. Recently acquired knowledge in climatology and extensive efforts to utilize it in buildings have pointed the way to rational development of structures better suited to the many diverse climatic regions of the United States. Articles and texts have been grouped under the following headings: climate control projects; background in science; designing with climate; and research and experiment.

Copies may be obtained from Housing and Home Finance Agency, Office of the Administrator, Division of Housing Research, Washington, D. C.

COMFORT COOLING for MORTUARIES



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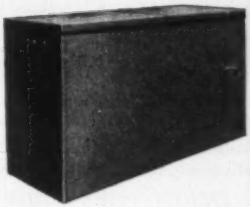

Striffler's Mortuary, Columbus, Georgia, like all other funeral homes, was faced with the need for air conditioning. The load was of comparatively short duration but all areas — reception room, store room and chapel — required different temperatures. DOLE Ice-Cels installed in the basement with cooling coils in the attic and forced air circulated through ceiling diffusers, solved the problem easily and economically. Each zone, with its different temperature level, is controlled by a separate thermostat while the Ice-Cel units are charged by a single compressor running in off-use hours.

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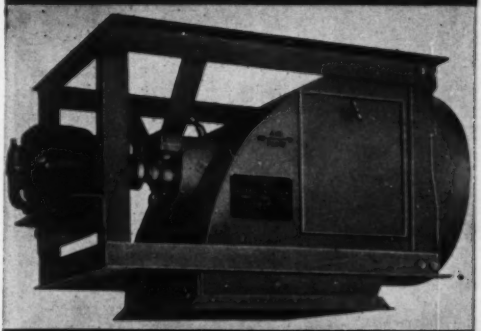
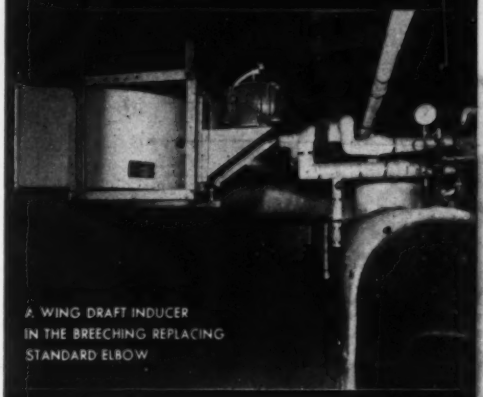


THIS IS A TYPICAL INSTALLATION



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1. **Eliminate tall, unsightly and expensive stacks. All that is left is a vent on the discharge.**
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IS THE GAS HEATING "BUY"

From coast to coast, you'll find Lo-BLAST Power-type Conversion Gas Burners heating buildings ranging from small residences to entire villages heated from a central plant. Preference for Lo-BLAST springs from proved efficiency, safety, durability . . . *operating records show an average saving of* 10%!

Compare these operating and construction features:

Power Burner Design. Perfect combustion, regardless of draft—a proved fuel saver. Safe and efficient for down-draft units.

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Soft, Quiet Flame. No "pop" when the Lo-BLAST goes on or off—burns so smoothly you can hardly tell it's running.

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Complete Capacity Range. Units available from 70,000 to 20,000,000 BTU input.

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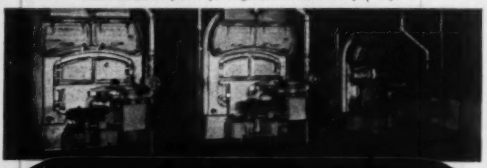

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MEETINGS & CONVENTIONS

IBR SCHOOL OF MODERN HEATING—The school of modern heating, sponsored by the Institute of Boiler and Radiator Manufacturers, 60 E. 42nd St., New York 17, is a travelling school designed to provide an intensive three-day training in heating design and installation. Classes will be held this month from July 11 to 13, at Odd Fellows Hall, 46 Beaver St., Albany, N. Y.; July 17 to 19, at Federation Building, Church & State Sts., Elmira, N.Y.; July 24 to 26, at Portland, Maine; and July 31 to August 2, at Burlington, Vt. Next month's meetings are scheduled for August 7 to 9, at Long Island Agricultural and Technical Institute, Farmingdale, L.I., August 14 to 16, at New Haven, Conn., and August 21 to 23, at Springfield, Mass. A list of the dates and locations of meetings to be held through December of this year is now available from the institute.

OAK RIDGE NATIONAL LABORATORY AND OAK RIDGE INSTITUTE OF NUCLEAR STUDIES—The third annual symposium sponsored by these organizations will be held at Oak Ridge, August 27 to September 7, and will take as its theme, "engineering in nuclear energy development." Sessions are open to all professional engineers. For details, write University Relations Division, Oak Ridge Institute of Nuclear Studies, P.O. Box 117, Oak Ridge, Tenn.

EIGHTH INTERNATIONAL CONGRESS OF REFRIGERATION—to be held in London, England, August 29 to September 11, under the auspices of The International Institute of Refrigeration. Accommodation for the meetings will be provided at Church House, Westminster. Additional information may be obtained from the secretary of the conference, Dalmeny House, Monument St., London, E. C. 3.

6th NATIONAL INSTRUMENT CONFERENCE AND EXHIBIT—Sponsored by the Instrument Society of America, 921 Ridge Ave., Pittsburgh 12. The affair will be held in the Sam Houston Coliseum, Houston, Tex., September 10 to 14.

INTERNATIONAL DISCUSSION OF HEAT TRANSFER—Postwar heat transfer developments will be the theme of a meeting, September 11 to 13, London, England. Plans for participation by engineers in the western hemisphere are being arranged by a joint committee on North American participation, which consists of representatives from some 12 professional and engineering societies. The American Society of Mechanical Engineers is coordinating administrative details.

BRITISH BUILDING RESEARCH CONGRESS—Sponsored by a number of professional institutions and societies, government departments, and representative industrial federations, the congress will be held in London, September 11 to 20. Additional information may be obtained from the organizing secretary, Building Research Congress 1951, Building Research Station, Bucknalls Lane, Garston, Watford, Herts, England.

Among the papers to be presented during the heating and ventilating sessions is one on heat transfer, by Prof. C. O. Mackey, Cornell University, and one on radiant heating by Prof. F. W. Hutchinson, University of California.

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FOREMOST IN POWDER-ACTUATED FASTENING

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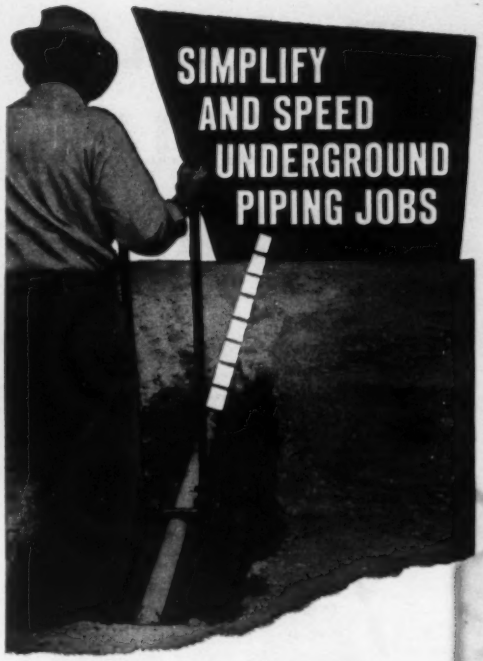

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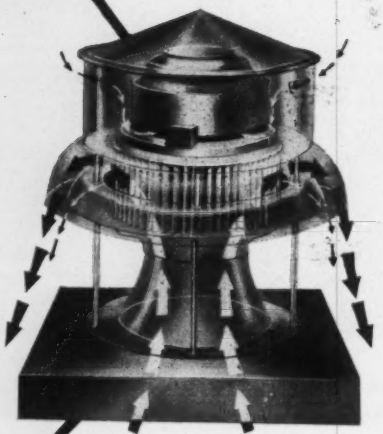

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1 CERTIFIED RATINGS

Gallaher performance data, the result of *independent* laboratory tests directed by a nationally recognized authority, reflects the top efficiency of the entire unit, *not* merely the fan wheel. Test data *is not* theoretical calculations but an accurate and actual performance picture.

2 SAFE FUME HANDLING

Air-Vans are designed with motor out of the air-stream to safely handle contaminates. Fresh clean air is constantly drawn thru the motor hood, creating a *positive air seal-off* around the motor shaft which absolutely prevents the passage of fume into the motor housing while unit is in operation.

3 SCROLL EFFECT

Gallaher research shows conclusively that you cannot achieve maximum efficiency beyond ¼" static pressure with a centrifugal roof exhauster *without Scroll effect.* Air-Van is the only roof exhauster with this feature.

These features together with many others—economy of installation and maintenance, rugged construction, weatherproof and architecturally sound design make the Air-Van outstanding.

CAPACITY 150-12,000 CFM; Static Pressures to 1¾"

Gallaher Air-Vans are available for immediate delivery.

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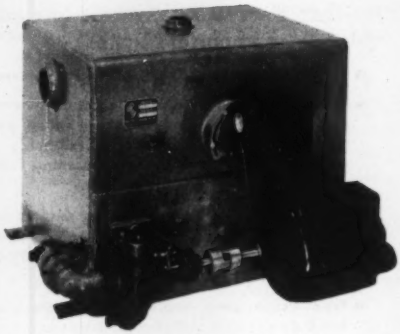

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Eagan Standard Units are made in single and duplex models to 150,000 sq. ft. E.D.R. at pressures to 200 P.S.I.

Your pump problems are invited. Eagan engineers or your local Eagan representative or the factory engineers offer their services for any pump requirement."

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1951 PUBLIC WORKS CONGRESS AND EQUIPMENT SHOW—The congress and show, sponsored by the American Public Works Association, 1313 E. 60th St., Chicago 37, will be held September 16 to 19 at Veterans Memorial Bldg., Detroit, Mich.

AMERICAN GAS ASSOCIATION, 420 Lexington Ave., New York City—The 33rd annual convention, St. Louis, October 15 to 17. The Jefferson hotel will be headquarters for the residential gas and industrial and commercial gas sections; the Mayfair and Lennox hotels for the operating section; and the Statler hotel will house the accounting section.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS, 919 Milam Bldg., Houston 2, Tex.—The annual meeting of the association's South Central Region is scheduled for October 18 to 20, at Corpus Christi, Tex.

CONFERENCE ON DESIGN AND CONSTRUCTION OF ATOMIC INSTALLATIONS—Co-sponsored by the American Institute of Architects and the U. S. Atomic Energy Commission, this conference will be held in October, in Washington, D.C. It will be conducted by the Building Research Advisory Board of the National Research Council. Discussions of atomic age architecture are planned.

THE 7th ALL-INDUSTRY REFRIGERATION AND AIR CONDITIONING EXPOSITION, to be held at Navy Pier, Chicago, November 5 to 8. The affair is sponsored by the Refrigeration Equipment Manufacturers Association, 1346 Connecticut Ave., N.W., Washington 6, D. C.

NATIONAL HEATING WHOLESALERS ASSOCIATION, 609 Union Commerce Bldg., Cleveland 14, Ohio—The annual meeting will be held at the Statler Hotel, Cleveland, December 3 and 4.

NATIONAL WARM AIR HEATING AND AIR CONDITIONING ASSOCIATION, 145 Public Square, Cleveland 14—The 1951 annual convention is scheduled for December 5 and 6, and will be held at the Hotel Cleveland, Cleveland.

Standards on Industrial Water Issued

The second edition of ASTM Standards on Industrial Water brings together in convenient form the various ASTM standard and tentative methods of sampling, analyzing, and testing industrial water. These methods have been developed particularly for the examination of water employed industrially in the generation of steam and for process or cooling purposes. The methods have been developed also for the examination of deposits formed from such waters.

The publication includes 31 methods which cover sampling, analysis, corrosivity tests, methods of reporting and general testing methods. Also included are specifications for substitute ocean water and standard definitions of terms relating to industrial water. A list of symposiums and technical papers on industrial water is included. Copies of this 168 page covered booklet can be obtained from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, for $2.00.

Airplane View of the Campus of a Large University on the West Coast of the United States — in Seattle, Washington. The Buildings are Heated from a Central Plant, the Steam being Transmitted through nearly 900 feet of Therm-O-Tile Underground Conduit.

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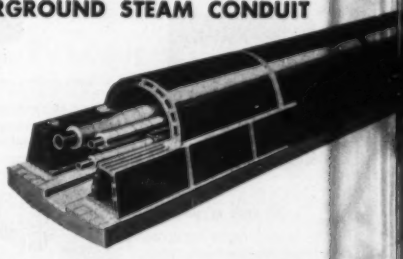

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Mercer Island School, Mercer Island, Wash.
Western College of Education, Bellingham, Wash.
Powell School, Powell, Wyoming.

Wherever you are, and whatever your underground pipe conveying problem, Porter-Hayden Engineers and Contractors will be pleased to help solve that problem. Therm-O-Tile is represented by Johns-Manville Technical Service Units in all principal cities.

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Modern heating plants use Perfex Draft Control Systems

SERIES 7875 FLUE GAS TEMP. INDICATOR

Provides continuous visual check on overall operating efficiency. Warns of wasteful conditions developing—failing baffles, fouled tubes, excessive draft, improper fuel, air ratios.

SERIES 7201 PROGRAM CONTROL

Establishes safe starting conditions for automatic burners. Opens damper, delays start, transfers control of uptake damper to draft control. Also maintains lower overfire draft.

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Large, easy-to-read dial . . . simple, positive adjustment. Gives continuous visual check on prevailing overfire draft for maximum efficiency.

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Causes actuator to reposition uptake damper, when required, to maintain correct overfire draft and reduce heat loss up the stack.

SERIES 6080 ACTUATOR

Powerful straight line action for regulating dampers. Many other individual applications.

Controls available individually or in package sets to conserve fuel, slash heating costs, reduce stack losses and smoke . . .

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RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 185. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.

Air Conditioning Systems

HPAC 101—Practical Pointers on Air Conditioning, a sixteen page booklet for both layman and expert, has been published by United States Air Conditioning Corp., 3300 Como Ave., S. E., Minneapolis 14, Minn. Covering all phases of air treatment and handling, the booklet describes the properties of air, the problems of its control, and the application of diversified types of equipment to solve these problems. Central plant systems, unit systems (including those for multi-room buildings) and standard units for built up systems are covered.

Air Conditioning; Commercial Applications

HPAC 102—A new 12 page booklet, B-5158, describing the benefits of air conditioning in beauty parlors, lunch rooms, factories, and other commercial and industrial establishments, is now available from Westinghouse Sturtevant Div., 200 Readville St., Hyde Park, Boston 36.

Aircraft Pipeline Identification

HPAC 103—An eight color printed specification form, T375, showing official Air Force-Navy standard identification codes for aircraft pipelines, has been issued by Topflight Tape Co., 116 E. Market St., York, Pa. The sheet conforms to AND10375 Air Force-Navy Aeronautical Standard sheets 1 and 2, and has been issued to supplement the government sheet, often in short supply. The company maintains a stock inventory of all designs shown.

Air Filters

HPAC 104—A revised 16 page catalog, DS1-S, covering available filter sizes for air filters used with air conditioning units has been issued by Owens-Corning Fiberglas Corp., Toledo 1, Ohio. The company's "Dust-Stop" filters are described, and the filters of various sizes produced by 31 other companies are listed (under the manufacturers' identification numbers, to facilitate ordering).

Ball and Roller Bearings

HPAC 105—SKF Industries, Inc., Philadelphia 32, Pa., is making generally available to engineers, product designers, maintenance men and engineering students its 270 page book, Ball and Roller Bearing Engineering. The text covers such subjects as bearing types and nomenclature, capacities, selection, design, installation, maintenance, causes of failures and load calculations. The price is $1.75, and requests should be directed to the manufacturer.

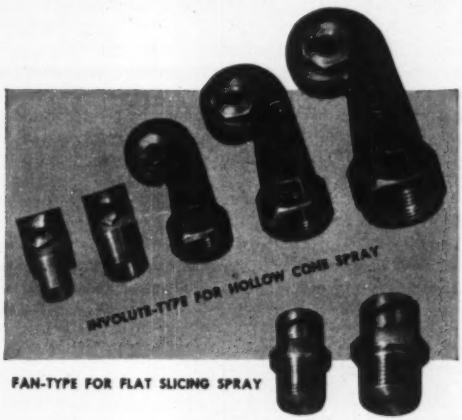
Baseboard Heating

HPAC 106—A simplified, rule of thumb method for estimating approximate heat losses, radiation requirements and material costs for its "Radiant-Ray" baseboard heating is a feature of the new Easy Estimator published by Radiant Baseboard Panels, Inc., 900 W. Main St., New Britain,

for • SPRAYING
• WASHING
• RINSING
• COOLING
• AIR CONDITIONING

YARWAY

SPRAY NOZZLES



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Get the most out of your Spraying Equipment with minimum power . . . with efficient spraying.

Use Yarway Nozzles. No internal vanes or other restrictions to clog or hinder flow. Two types—Yarway Involute-type producing a fine hollow spray with minimum energy loss, and Yarway Fan-type producing a flat fan-shaped spray with time-saving slicing action for cleaning.

Wide range of standard sizes and capacities. Cast or machined from solid bar stock.

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The Revolving Discharge Outlets Flood the Working Area with a Blanket of Fresh, Live, Pleasantly Warmed Air—

THE gentle air motion caused by the constantly changing directions of the heated air from the revolving discharge outlets eliminates the hot blasts and chilly areas common with stationary discharge type unit heaters—creates a refreshing, stimulating atmosphere beneficial to employee morale and productivity.

Successful applications of Wing Revolving Heaters have been made in every type of industrial plant, as well as other buildings with unique heating problems. Get complete information on this modern form of unit heating by writing today for a copy of Wing Bulletin HR-5.

L. J. Wing Mfg. Co., 140 Vreeland Mills Road
Linden, New Jersey

Factories: Linden, N. J., Montreal, Can. In Europe: WANSON, Brussels, Belg.

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Revolving
UNIT HEATERS

Proving THEMSELVES *in*
INSTALLATION *after* INSTALLATION

Time after time, Sterlco Condensation Pumps have proven they can do a better job — and there are many reasons why. Take, for instance, the Sterlco 4200 Series Condensation Pump. It is designed to do one job, and do it outstandingly well. Rated conservatively, the 4200 can actually safely deliver its full rated output continuously for long periods — and its many exclusive features cannot be found in much higher priced pumps. Yes, it's no wonder Sterlco *always* does a better job.

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- LARGE CAPACITY TANK
- COMPACT, NEAT APPEARANCE
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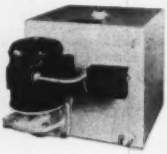

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Conn. Also given are simplified installation data, forms for computing individual room requirements, etc. Not intended to replace detailed estimations as suggested by IBR and other authorities, the booklet is designed as a handbook and work sheet for heating contractors.

Blower Wheel

HPAC 107—An illustrated folder issued by Mayne Products Co., 324 Harries Building, Dayton 2, O., describes the company's blower wheel, available in seven standard sizes. The wheel is composed of eight parts — two blade sections (one superimposed upon the other), two end rings, two spiders and two hubs.

Calcium Silicate Insulation

HPAC 108—Hydrous calcium silicate, a completely reacted compound of lime and sand produced by Kaylo Div., Owens-Illinois Glass Co., Toledo 1, O., is used as insulating roof tile, pipe and boiler insulation, as cores for firedoors and laminated building panels, and for other special applications (as absorption units in humidifiers, electronically detonated heads for open hearth furnace tappers, etc.). The research and development history of the product is covered and its properties described in a new 24 page booklet now being distributed by the manufacturer. Also outlined are the characteristics of the company's laminated panels and firedoors.

CO_2 Recorder

HPAC 109—A new condensed, illustrated bulletin, 51-553, on its automatic CO_2 recorder is now available from Hays Corp., Michigan City, Ind. It covers application of the instrument and a description of the orsat principle of operation. Special features (temperature compensation, self leveling, etc.) are explained and installation and sampling are described. A selector chart — a guide to mountings and various models — is included.

Cooling Towers

HPAC 110—A new bulletin, No. 401-A, on its induced draft cooling towers (3 to 11 tons) has been released by Acme Industries, Inc., Jackson, Mich. Housing fan, filling eliminator and other component parts of the units are described. Included are nominal capacities, general dimensions and ratings (78 deg wb for both 7½ and 10 deg water range).

Draft Control

HPAC 111—Three new bulletins covering automatic controls and instruments for its draft control systems, are now available from Perfex Corp., Industrial Controls Dept., Milwaukee 7, Wis. One bulletin deals with oil, a second with gas, and a third with stoker firing. Control functions of the company's equipment are outlined (draft control in the firebox during "off" periods, damper opening before restarting burner, switch to automatic draft control during burner operation) and application of each control is illustrated. Wiring diagrams show how the company's equipment can be incorporated into burner control systems.

Flush Latches and Hinges

HPAC 112—A new catalog featuring its complete line of flush latches and hinges has been issued by Hartwell Co., 9035 Venice Blvd., Los Angeles 34, Calif. Typical

MAINTAINED SKIDMORE PUMPS EFFICIENCY

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Consult Skidmore

. . . FOR A SPECIFIC PUMP REQUIREMENT.

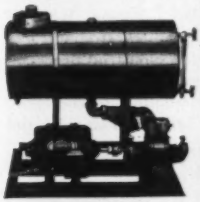
If you are faced with the responsibility of a choice, Skidmore offers many types and units for you to select the correct design to meet your individual requirements.

Type UV Condensate Pump

Type UV Condensation Pump is designed for below floor level returns, and is built in single and duplex units.

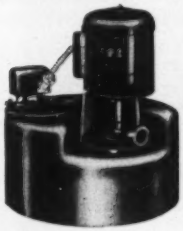
Type HS Condensate Pump

Type HS Pump is recognized for its dependable low operating cost. Capacities range from 1,000 to 65,000 sq. ft. EDR and pressures from 10 to 75 pounds.



Type TM Turbine Pump

Type TM High Pressure Turbine Pump. Designed for pressures up to 150 pounds and boilers to 250 H.P.



Type CV Vertical Pump

Type CV Vertical Pump is ideal where space is limited. This model like every Skidmore Pump is built to meet specific requirements. For the correct solution to your own pump problem consult a Skidmore Heating Pump Specialist.

Skidmore Pumps

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MODEL A-555

THE AUTOMATIC SHUTTER WITH ALL THE FEATURES

FRONT VIEW—CLOSED

IT TAKES THE LOAD OFF THE FAN!

Aluminum louvers open fully, permitting capacity fan operation. New heavy reinforcement strip adds strength and long life to the louvers, assures quiet operation and perfect counterbalance, prevents rattling. Deep shroud protects shutter from high winds. Tie-rod, brackets and bearings inside frame, not exposed to weather. Special finish resists corrosion. Many other features.

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Power Fixed and Squirrel Cage
FANS

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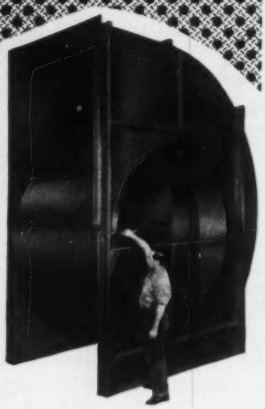
Backward curve blade type with non-overloading characteristics. Housings constructed of steel plate and reinforced with heavy bracing angles. Wheel sizes Single Width 13½" to 86½" dia. Double Width 18" to 86½" dia. Class I or Class II construction for better fan selection.

SQUIRREL CAGE FANS

Fan wheels have low speed characteristics. The low air velocities permitted are conducive to efficient operation. Housings are rugged and compact. Wheel sizes Single Width 13½" to 86½" dia. Double Width 18" to 86½" dia.



Housing shown above for 86½" wheel

Write for catalogs.

MASSACHUSETTS BLOWER DIVISION
The BISHOP & BABCOCK Mfg. Co.
4901 HAMILTON AVENUE CLEVELAND 14, OHIO

applications are illustrated, and diagrams show dimensions, installations, etc.

Heat Exchange Medium

HPAC 113—New laboratory data on the use of "Platecoils" as a medium of heat exchange are available in a technical manual recently published by Platecoil Div., Kold-Hold Mfg. Co., Lansing, Mich. Data are based, in part, on research conducted by the Battelle Memorial Institute, Columbus, O. The manual supplies charts and formulas to aid in the basic calculations needed for industrial heating and cooling applications.

Heating Pumps

HPAC 114—Methods for selecting pumps of the proper type and capacity for steam heating systems or steam heated apparatus are presented in a new 18 page manual, No. 1495, issued by C. A. Dunham Co., 400 W. Madison St., Chicago 6. The prime operating functions of vacuum and condensation pumps are described and illustrated, and installation diagrams show piping connections needed for a variety of conditions.

Heating Specialties

HPAC 115—Traps, valves, and other specialties for steam and hot water heating installations are covered in bulletin 1501, issued by C. A. Dunham Co., 400 W. Madison St., Chicago 6. The bulletin outlines the design and construction of more than 20 items, giving a complete range of applications for a variety of operating conditions, and including capacity, weight and dimensional data in table form. Cross sectional drawings and photographs illustrate each item.

Heat Transfer Surfaces

HPAC 116—A new bulletin, form 00345IM, issued by Modine Mfg. Co., Industrial Div., Racine, Wis., illustrates a variety of specialized heat transfer surfaces which the company has developed for industrial processes and products. Surfaces shown are applicable to equipment used for solvent recovery, intercooling, regeneration, gas separation and liquefaction, heat economizing and drying, and similar applications.

Hose Clamps and Fittings

HPAC 117—A new 12 page catalog, No. 300, prepared by Punch-Lok Co., 321 N. Justine St., Chicago 7, lists the company's standard hose clamps, locking tools and special fittings, and describes and illustrates their applications.

Hose Lines and Fittings

HPAC 118—Aeroquip Corp., Jackson, Mich., has issued a new industrial catalog covering the construction and principles of the company's hose lines and detachable, reusable fittings. Information is given on how to order parts.

Industrial Chemicals

HPAC 119—Aluminum Co. of America, 680 Gulf Building, Pittsburgh 19, Pa., has prepared a 14 page illustrated booklet on its East St. Louis, Ill., research laboratory, which serves the company's subsidiary, Aluminum Ore Co., manufacturer of industrial chemicals, principally the aluminas and fluorides. The booklet describes the labora-

A *Tough* Welding Problem

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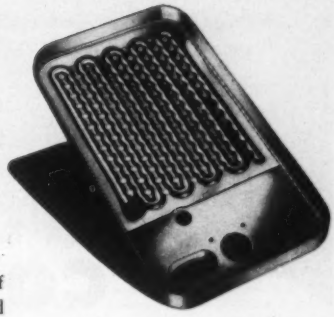

The refrigerated container bottom shown at the right is fabricated of *stainless clad copper sheet* which is spot, seam and projection welded and then tested at 500 lbs. pressure, to form the piece you see.

AUTORAD has contributed entirely new stamping and welding advances in the fabrication of stainless clad copper, combining the cleanliness and strength of stainless steel with the rapid heat transfer of copper in the manufacture of heat exchanger plates and containers.

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Manufacturers of Heat Transfer Equipment Since 1920

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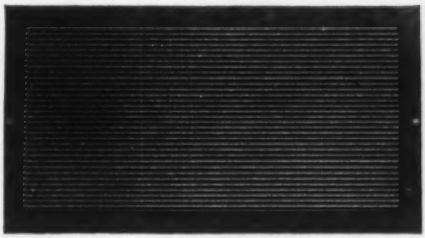
No Matter How You Look At It — This A-J GRILLE is Better!

(Illustration 70-B)

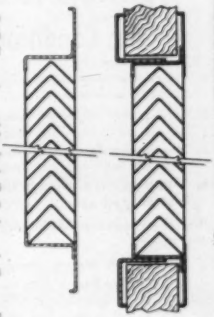


That's right. No matter how you look at it you'll agree this A-J No-Vision Door and Partition Grille is better. The following reasons tell the story.

Rigid construction: Louvers are made of aluminum and spaced on 1/3" centers securely welded in a steel flange frame.

Maximum free area: Free area (approximately) 70% variable.

Installation costs are cut: The exclusive telescoping A-J AUXILIARY FRAME assembly which slides over the core, permits an easy and attractive installation which presents the same appearance on either side thereby reducing expensive molding costs.



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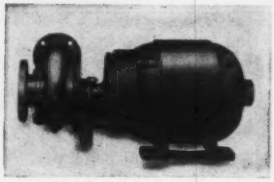

Fig. 3650 Close-Cupld Centrifugal

Four Ways To Get More Satisfied Air Conditioning Customers

1. Quiet operation. A Goulds Close-Cupld pump is the next thing to noiseless.
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4. Compact units. Goulds Close-Cupld packs a lot of pump in a small package.

For larger jobs Goulds Double-Suction Centrifugals are equally dependable.

It will pay you to investigate Goulds Close-Cupld line. (Call or write Pump Headquarters for complete information.

Goulds PUMPS INC. Seneca Falls New York

tory building and its equipment and discusses many products developed there.

Industrial Incinerator

HPAC 120—A new catalog covering type FG-4 of the "Brule" incinerator line, has been issued by Goder Incinerator Corp., 407 S. Dearborn St., Chicago 5. This unit, used for a variety of industrial applications, is available in 15 standard sizes (ranging in capacity from 400 to 4000 lb per hr wet), and in three special models, two of them portable.

Liquid Measuring Meters

HPAC 121—A new bulletin, no. OG400, intended as a guide to the proper selection of meters for measuring more than 200 liquids with varying corrosive characteristics, has been issued by Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh. Included are data on liquids ranging from absorption oil to zinc chloride, and including those encountered in food, beverage, paint, and other industries. The meters covered range in size from ½ in. to 3 in., measure in gallons, Imperial gallons, barrels or liters, have totalizer capacity of up to seven figures, and are available in six types of registers.

Manual Starting Switch

HPAC 122—A new eight page bulletin featuring the "Bulletin 600" manual starting switch has been prepared by Allen-Bradley Co., Milwaukee, Wis. The six switch models and a variety of standard enclosures are described and illustrated. Dimensional and engineering data are given.

Motor Controls

HPAC 123—A new 92 page edition of its "Handy" catalog on motor controls has been published by Allen-Bradley Co., Milwaukee, Wis. Included are condensed information, dimensions, and prices of many items in the company's line of controls. An a-c and d-c index along the margins of each page have been added.

Motors

HPAC 124—A new four page illustrated bulletin issued by Wagner Electric Corp., 6400 Plymouth Ave., St. Louis 14, gives full information, including hp ratings, voltage requirements, etc., on its single phase motors (repulsion-start, capacitor-start, and split phase inductions, etc.); its polyphase motors (open type, totally enclosed, etc.); its squirrel cage motors (totally enclosed fan cooled, etc.) and its special motors (jet pump, oilwell pumping, gear motors, etc.). Also described are the dry type distribution transformers.

Motor Service

HPAC 125—Product Service Div., A.O. Smith Corp., 8312 S. Chicago Ave., Chicago 17, is now distributing a four page illustrated bulletin listing all the company's authorized motor service stations throughout the country. A map shows the service stations, the company's four product service branches and two electric motor factories.

Oil Burning System

HPAC 126—Bulletin 109-B, issued by Peabody Engineering Corp., 580 5th Ave., New York 19, N.Y., describes the company's constant differential pump system for use

IF YOU USE **SPRAY NOZZLES** HAVE THESE FACTS

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the internal design and capacity of the spray nozzles used in a spraying operation often determine the cost and quality of that operation. See for yourself why Spraying Systems spray nozzles are the SPECIFIED nozzles of industry today. Write for Catalog 22 — the facts are all there.

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Catalog 23, Pneumatic Atomizing Nozzle Catalog

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How to promote greater PER-MAN productivity!

Well-ventilated working environments contribute to faster, better defense production.

Western Rotary Turbine Ventilators provide constant, round-the-clock exhaust *without power.* A 2-mph breeze keeps your Western Rotary System in operation. Lifetime guaranteed bearings are both mounted on the same axis . . . always stay in alignment. Throat sizes 6" through 48", with the clean, low silhouette progressive industry demands.

Complete, up-to-the-minute information, sizes, capacities, and prices on all Western equipment upon request. In 1951 SWEETS and A. E. C.

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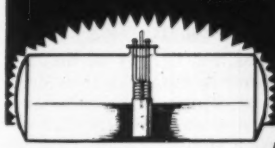
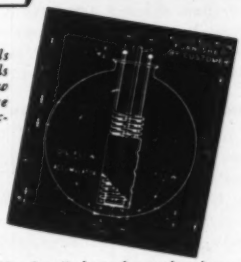
PREHEAT HEAVY OILS IN STORAGE TANKS

REMPE "Hot Spot" PREHEATER



Write for details and price.



Preheats fuel oils and other liquids to proper flow temperature before entering the suction line.

No. 5 and Bunker C oils flow more freely at high temperatures — have greater BTU value.

The Rempe "Hot-Spot" does the preheating job efficiently. Takes the load off the suction pump.

All-steel construction. Inlet and outlet pipes furnished in required lengths for any diameter tank. Steam or Hot Water can be used as heat source. Made with 14" or 16" diameter shell.

REMPE COMPANY

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T-70 Room Thermostat

A-100 Thermopilot Relay Automatic Reset

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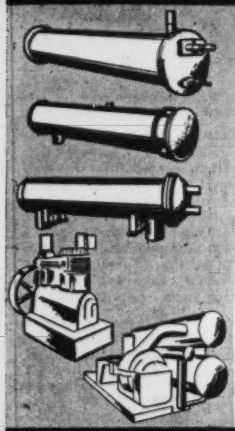

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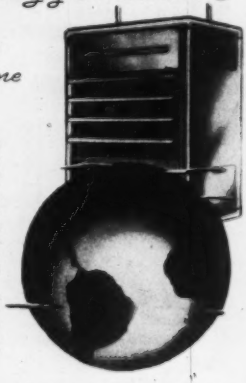

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in oil combustion installations. A typical installation is used to illustrate the possible control range of the system (a steaming range of 20 to one or more with all burners in service).

Oil Heaters

HPAC 127—An enlarged catalog, No. 0-51, prepared by Water Tube Boiler and Tank Co., Inc., 140 W. Root St., Chicago 9, covers the company's "Gas-Tu-Bo" oil preheater, which heats the oil indirectly by gas and operates independently of the boiler; the "Wa-Tu-Bo" safety oil heater, so constructed that oil cannot enter the boiler water if an oil heating tube fails; and the type U tube oil heater, for low cost installation. Capacities and dimensions are given, and special features are illustrated and described.

Oil Heating Equipment

HPAC 128—A new manual on the installation and servicing of oil heating equipment is being offered by Century Engineering Corp., Cedar Rapids, Ia. The section on commercial burners includes information on installing combustion chambers, fuel oil tanks and piping, chimney and smoke stacks and electrical data. Also covered is general servicing of burners. Graphs and charts for altitude corrections, efficiency charts, forced air duct layout procedure, etc. are included. Requests should be addressed to the company. There is a 50 cent charge for cost of mailing and handling.

Perimeter Insulation

HPAC 129—For heating equipment manufacturers and owners, builders, and contractors, Owens-Corning Fiberglas Corp., Toledo 1, Ohio, has prepared a 20 page booklet, D51-6, on perimeter insulation for standard heating systems. The need for such insulation is discussed, and step by step instructions are given for the installation of the company's "Fiberglas" perimeter insulation.

Power Transmission Chain Drive

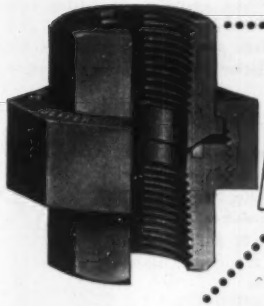
HPAC 130—A new catalog, No. C 72-51, on the "Hy-Vo" power transmission drive is now available from Morse Chain Co., 7601 Central Ave., Detroit 8, Mich. Included are a discussion of the operating and design principles of the chain drive, a description of its applications in high speed, heavy duty power transmission and of its capacities, speed ranges, etc. Service factors for selecting drives and installation and lubrication procedures also are outlined.

Radiation Heating Equipment

HPAC 131—The selection and application of radiation heating equipment for steam or hot water systems are treated in manual No. 1295 (32 pages) recently released by C. A. Dunham Co., 400 W. Madison St., Chicago 6. Designed to guide architects, consulting engineers, jobbers, and heating contractors in specifying, selling and installing convector, baseboard and fin-vector radiation, the manual contains capacity tables, drawings and diagrammatic sketches covering typical installations.

Refractory and Insulating Materials

HPAC 132—A new catalog issued by Refractory & Insulation Corp., 120 Wall St., New York 5, N.Y., gives information on applications, installation procedures, special features, specifications, etc. of the company's refractory and insulating materials. These include refractory



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Close fits are simple with Jefferson Unions . . . and once in they'll STAY in because we make them from a very fine malleable iron with a tensile strength of 55,000 lbs per sq in. Details such as the machining instead of casting the ring channels . . . making the rings from special tubing instead of casting them and testing all fittings with air before delivery all add up to a minimum of maintenance after the installation. You're sure the job's in to stay when the joints are made with Jefferson Specialty Unions.

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You *can* get a solenoid valve that operates under differential pressures up to 150 lbs., temperatures to 400°F., *without pilot valves*. It ends the time lag and wiredrawing that come with slow opening —the danger of sticking that comes with auxiliary pistons. It offers unusual possibilities for all types of automatic, or remote, flow control. Johnson Solenoid Valves are available for normally closed or normally open service; with stainless steel valve and seat or Jenkins disc; in sizes from ½" to 3".

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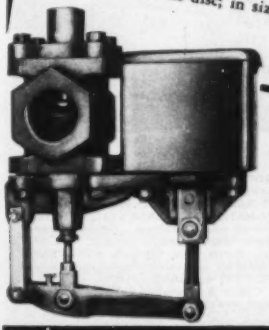

WHERE CAN YOU USE THIS AUTOMATIC VALVE?

- No pilot valves
- Temperatures to 400°F.
- Differential Pressures to 150 lbs.
- Immediate full flow
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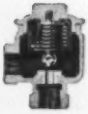

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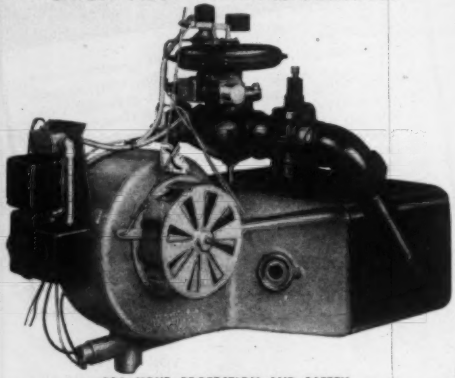
LATEST MODEL FEATURES NEW AUTOMATIC SAFETY PILOT and TRIPLE CONTROLS



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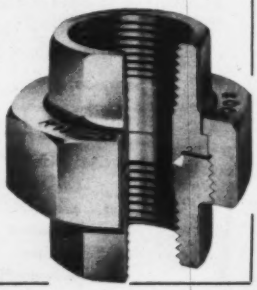

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cements (castable, chrome base castable, air setting and heat setting bonding) and ramming type refractories, and insulating blocks and blankets, plastic heat insulations, fill insulations, electrical insulations and surface protective coatings.

Rivets and Rivet Guns

HPAC 133—A condensed, 8 page catalog, C51, covering its standard rivets and tools, has been prepared by Cherry Rivet Co., 231 Winston St., Los Angeles 13, Calif. There are diagrams and specification tables on the company's blind rivets and rivet guns, and applications in manufacturing, repair and maintenance are described and illustrated.

Roof Cooling Systems

HPAC 134—The advantages of roof cooling systems are discussed in a new four page illustrated bulletin, No. 20, issued by Water Cooling Corp., 71, Nassau St., New York 38, N.Y. Specifications for such systems are given, and the company's equipment (special wide angle nozzles, swivel joints, adjustable ball joints, adjustable redwood supports) is described.

Safety Heads

HPAC 135—Black, Sivalls & Bryson, 7500 E. 12th St., Kansas City, Mo., has prepared a 52 page publication (section 10, part 1, catalog 54) which gives dimensions, ratings, etc., for its various types of safety heads and safety head accessories. Typical installations are shown, and a theoretical relieving capacity table is given.

Self-Tapping Screws

HPAC 136—Parker-Kalon Corp., 200 Varick St., New York 14, has prepared booklet No. 480, a revised, 24 page assembly handbook covering the selection of its self-tapping screws, application information, recommended hole sizes and corresponding drill size numbers.

Spray Nozzles

HPAC 137—A new, revised 20 page bulletin, N-617, covering spray nozzles for water cooling, air conditioning, and general industrial uses, has been released by Yarnall-Waring Co., Mermaid Lane, Philadelphia 18, Pa. Capacities, dimensions, and special features are given for the company's involute nozzles used in spray cooling ponds and for smaller involute and flat-spray nozzles used in industrial processes. The various applications of different type spray nozzles are listed.

Stoker Feeder Conveyor

HPAC 138—The new "Flo-matic" boiler stoker feeder screw conveyor of American Coal Burner Co., Inc., 18 (B) East Erie St., Chicago 11, is described in an illustrated specification sheet. Delivery capacities and special features are included. A diagram shows a typical installation.

Strip Chart Potentiometer Controller

HPAC 139—A new two page sheet no. 175, available from Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Station 40, Wayne and Windrim Aves., Philadelphia 44, gives engineering specifications of the company's new "Electronik" strip chart pneumatic control potentiometer.

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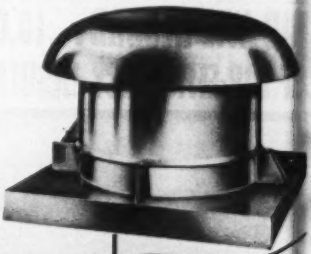

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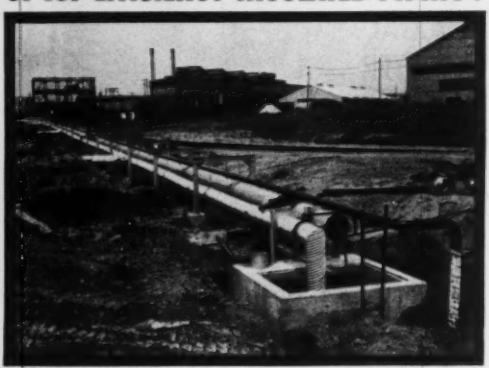

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Tachometer

HPAC 140—Technical data sheet No. 42P, issued by Metron Instrument Co., 432 Lincoln St., Denver 9, Colo., describes the company's new tachometer (three range, single head, fixed type) for applications where an unusually wide range of speed measurement is desired. Special features, applications, installation methods and servicing are discussed. The different types of tachometer heads which may be used with the indicator also are described.

Totally Enclosed Motors

HPAC 141—A new bulletin, 05B7150A, issued by Allis-Chalmers Mfg. Co., 1171 S. 70th St., Milwaukee, Wis., describes types of construction and ratings of the company's improved totally enclosed, fan cooled motors with tube type, air-to-air heat exchangers. They are available in squirrel cage, wound rotor and synchronous types for both horizontal and vertical installation.

Ultra-violet Germicidal Unit

HPAC 142—D. William Fuller Co., 2320 E. 75th St., Chicago 49, has issued a specification sheet, form No. 6000 4-51, covering its ultraviolet germicidal unit which can be installed in warm air heating plants or air conditioning systems to purify indoor air and protect against bacteria. Dimensions, voltage requirements, etc. are given for the two, three and four tube units for small air conditioning systems, and for the two and four tube models for larger systems. Recommendation tables give number of units needed for heating and conditioning systems of various sizes (by Btu input and cfm).

Underground Pipe Conduit

HPAC 143—H. W. Porter & Co., Inc.-Reid Hayden, Inc., 825 Frelinghuysen Ave., Newark 5, N.J., has issued an eight page illustrated bulletin, No. 511, describing its "Therm-o-tile" conduit for hot or cold underground pipe lines. Photographs show step by step installation procedure, and specifications are given for underground steam conduit systems — including a tabulation of the thicknesses of pipe covering necessary with various steam pressures.

Unit Heaters

HPAC 144—A guide to the installation of unit heaters of various types and capacities, handbook No. 1395, has been published by C. A. Dunham Co., 400 W. Madison St., Chicago 6. Propeller fan unit heaters of the horizontal and vertical discharge types and cabinet type centrifugal fan heaters are described. Diagrams show heat spread patterns and various mounting heights for horizontal and vertical discharge heaters. Installation instructions and recommended piping hookups are given for heaters used with both steam and hot water systems. Floor plans of buildings of various sizes show the number and location of heaters needed to give complete warm air coverage.

Unit Heaters for Waste Heat Recovery

HPAC 145—Utilization of unit heaters for recovery and distribution of waste heat from engine and compressor jacket water is covered in a new bulletin, 00531A, issued by Modine Mfg. Co., Racine, Wis. Several installations are described to illustrate piping hook ups and control methods. Basic hot water capacities of the company's unit heaters are given in performance tables, and the method

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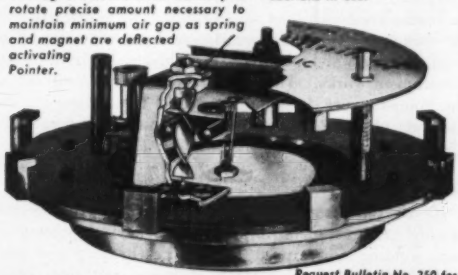

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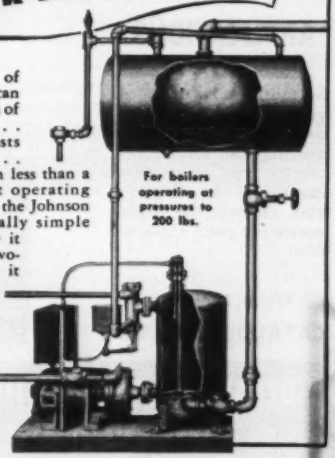

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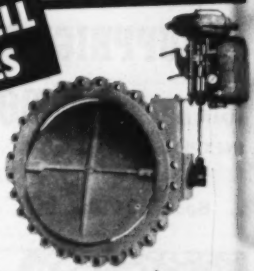

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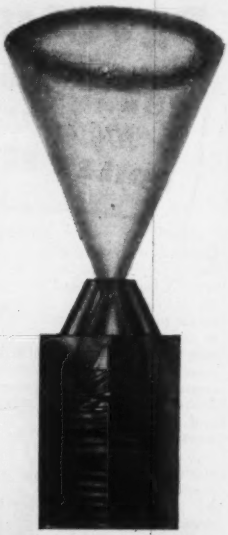

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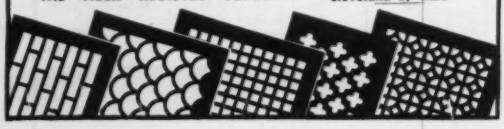

for selecting the correct size and type of heater is explained.

Valve Piping

HPAC 146—A new sheet, F-4774, illustrating installation hints for fitters and dealing with valve piping, is available from Barber-Colman Co., Rockford, Ill. "Right" and "wrong" wrench positions are shown, and methods for avoiding strained, crushed or twisted valve bodies are stressed.

Water Treatment and Conditioning

HPAC 147—Brooks Chemicals, Inc., 3304 E. 87th St., Cleveland 27, O., has published a 16 page booklet, No. 501, on water treatment and conditioning, with emphasis on the company's services, products and methods which are used to solve water problems in industry, institutions and government works. The seven types of service offered by the company are fully outlined and the causes of, and methods of combatting some common water impurities also are discussed.

Welding Alloys

HPAC 148—A new edition of its six page folder containing specifications of almost 100 different low temperature welding alloys used in welding, brazing and hard surfacing of steel, alloy steels, stainless, cast iron, brass, bronze, copper, etc., is now available from Eutectic Welding Alloys Corp., 172nd St. and Northern Blvd., Flushing, N. Y.

Welding Engineering

HPAC 149—The third edition of Manual of Welding Engineering and Design (50 pages) has been issued by Eutectic Welding Alloys Corp., 40-40 172nd St., Flushing, N.Y. This latest printing contains additional information on joint preparation by means of electric arc, and gives data on design, latest welding alloy developments and new welding aids.

Welding Fittings

HPAC 150—Tri-Clover Machine Co., Kenosha, Wis., is now offering catalog 1051 (16 pages) describing its new line of 5 and 10 IPS size stainless steel "Zephyrweld" welding fittings, for use with light gage pipe in many industrial applications. Specification tables, diagrams and photographs cover 45 deg elbows and laterals, 90 deg elbows, true Y's, straight and reducing tees, straight and reducing crosses, concentric reducers, caps, and other fittings. Friction loss tables also are given.

Wrought Iron Pipe

HPAC 151—Now available from A. M. Byers Co., Engineering Service Dept., Pittsburgh, Pa., is a four page bulletin, 27/By, containing the wrought iron pipe data most frequently required by technicians in their design and specification work. Consolidated tables list size and dimensional data for both standard and extra strong pipe and contain information on threads per in., mill test pressures, circumference, external areas, length per sq ft of surface area, and other general data needed for heating, flow and weight calculations. Chemical composition and general and special applications also are discussed.

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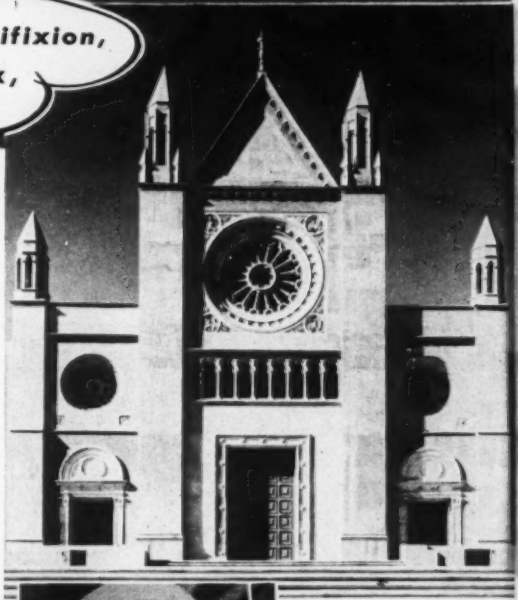
CLARAGE HEAVY-DUTY FANS

HELP PROTECT FOR POSTERITY

WORLD'S LARGEST MASTERPIECE OF HOLY ART

. . . . in the Hall of the Crucifixion, Forest Lawn Memorial-Park, Glendale, California



Completed in 1895, Poland's great artist, Jan Styka spent 17 years painting the Crucifixion. A city block long, four stories high (195′ by 45′) — it contains 1,182 human figures.

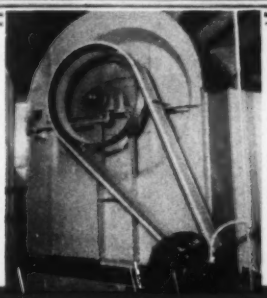
After 50 years in obscurity, this holy art now hangs in the new Hall of the Crucifixion — in the famous Forest Lawn Memorial-Park.

Dedicated this year on Good Friday, the Hall is an auditorium-type structure built to house the picture and permit 2,000 people to view it.

To provide human comfort and to guard the fabulous canvas from deterioration is the two-fold responsibility of the auditorium's complete air conditioning system.

Here, as on so many other important conditioning jobs, **no mistake was made by installing Clarage HEAVY-DUTY fan equipment.**

CLARAGE FAN COMPANY
KALAMAZOO, MICHIGAN



ARCHITECTS:
Architectural Department of Forest Lawn Memorial-Park

ENGINEERS:
Stockley and Bamford, Los Angeles

CONTRACTOR:
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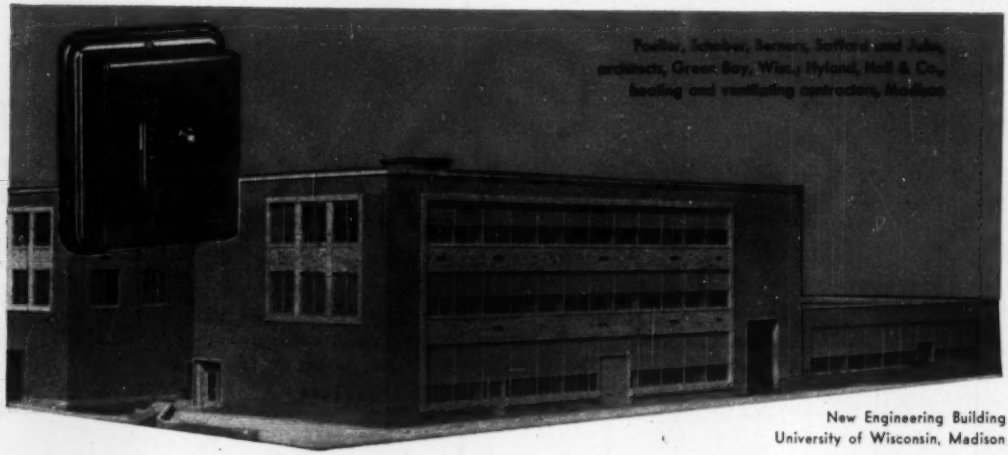
CLARAGE

—HEADQUARTERS for Air Handling and Conditioning Equipment

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES



New Engineering Building
University of Wisconsin, Madison

When colleges build

JOHNSON CONTROLLED TEMPERATURE

SAVES FUEL DOLLARS

College classroom and laboratory buildings usually are in use from eight o'clock in the morning until five in the afternoon. Much heat is wasted when all rooms are maintained at "occupancy" temperature, at night and over the week-end. That fact was realized in planning the first unit of the new Engineering Building at the University of Wisconsin, to house the Electrical Engineering and Mechanics Departments.

Johnson *Dual* Thermostats, 135 of them (at least one in every room and corridor), control Johnson Valves on 190 convectors. The instruments are designed to maintain proper occupancy temperatures in areas which are in use or reduced economy temperatures in spaces which are vacant. A central time switch resets the *Dual* Thermostats according to the usual program for each day of the week. Merely by pushing a button on the cover of the instrument, the occupant of a room which is occupied at odd hours may restore the temperature in that one space to the normal comfort level.

Johnson Control, in Wisconsin's newest Engineering Building, is applied also to unit ventilators in shops, ventilating systems for interior corridors and air conditioning equipment which serves laboratories where certain conditions must be maintained the year around.

Investigate Johnson *Dual* room-by-room temperature control now. It is equally adaptable to new and existing installations. Whatever the temperature problem may be, call a Johnson engineer from a nearby branch office. There is no obligation. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.

JOHNSON *Automatic Temperature and Air Conditioning* **CONTROL**

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